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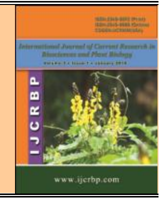

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Structure and Floristic Diversity of the Woody Vegetation of the Mount Kupe Submontane Forest (Moungo – Cameroon)

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Abstract

This study aims to evaluate the vegetation structure and diversity of woody species in the sub mountain forest of Mount Koupe (Moungo-Cameroon) between 1 000 and 1 800 m and to appreciate the index values obtained with those of the tropic, Malagasy and Neotropical region of the world. The basic data have been obtained on inventory of 1-ha plot taking into account all trees whose diameter at breast height (dbh) ≥10 cm. The parameters of floristic diversity were calculated using the standard methodology. A total of 1184 individuals belonging to 156 species, 114 genera and 51 families were inventoried, with the total basal area of 151.44 m²/ha. Most individuals (trees) had between 10 and 20 m height with diameter between 50 and 80 cm, but relatively a significant number of individuals (05) reached even higher values, up to 30 m height and 135 cm of diameter. The five most important families in terms of density, diversity and dominance were *Meliaceae*, *Euphorbiaceae*, *Rubiaceae*, *Malvaceae* and *Burseraceae*. They represent 52.53 % of the Family Important Value (FIV). The specific composition revealed that 10 species dominate the submontane forest, 6.41 % of species represent 54.50 % of the Index of Value Importance (IVI). They are *Carapa procera*, *Santiria trimera*, *Strombosia pustulata*, *Cola acuminata*, *Turraeanthus africana*, *Penianthus longifolius*, *Allanblackia gabonensis*, *Drypetes leonensis*, *Pycnanthus angolensis* and *Sorindeia grandifolia*. A fraction of species (70) then 44.87 % is represented by one individual. In conclusion, the Kupe submontane forest is marked down substantially to the lowland forest. The family of *Leguminosae* which dominate in these levels does not occur among the 10 important families in FIV; they come in the 14th position. The *Rubiaceae* occupies 1st position in in relative diversity and 2nd position in FIV mark in this altitudinal stretch.

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Keywords

Kupe Mountain
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Introduction

The Kupe Mountain (2064 m altitude) has a submontane forest between 800m - 1800m altitude, belonging to the Guinean-Congolese region (Letouzey, 1985). One notes that the Cameroonian Mountains with the specific example of Mount Kupe belong to the Cameroon afromontane archipelagos which are connected comfortably (from the floristic point of view) to the other archipelago highlands of East and Southern Africa (White, 1983). The submontane storey in Cameroon has witnessed several phytosociological studies (Noumi, 1998; Noumi and Amougou, 2003) and phytogeographical studies (Noumi, 2012, 2013, 2015; Madiapevo, 2008; Tagne, 2007; Tchoua, 2013). These studies established the individual groups and syntaxa in part and also led to the determination of the families' and species' quantitative parameters for these types of forests.

These works although are concerned only with the low levels of submontane storey heights reach. They do not cover the whole altitude of the submontane storey and are not therefore representative of the entire zone. This research therefore attempts to answer the question: *"Are the characteristic parameters of the structure and diversity of the Mount Kupe submontane forest different from those of previously determined parameters in the highland forests?"*

The purpose of the study is sample the Kupe forest by sampling biplots, taking into account trees with diameter at breast height (DBH) ≥10cm, to establish quantitatively its parameters of diversity and to characterize the forest compared to the known data of the African, Asiatic and neotropical forests.

Materials and methods

Study Area

The Kupe massif (4^0 44'- 4^0 52' latitude North and 9^0 41'- 9^0 52' longitude East) covers a planimetric surface area of 210ha thereabout. It is formed by the outfit of three summits: « Nature trail », « Mean trail » and « Maxis trail ». This last-mentioned, is the highest and reaches 2064 metres at its highest point (Fig. 1). Several villages surround the massif: Nsuke, Mbulle, Bendume, Mpacko, Tape-Etube, Ndom and Nyassosso (on the South West regional side); Ngab, N'lohé, Lala and Kola (on the Littoral regional side). The Mount is a volcano-tectonic horst (Lamilen et al., 1998) with irregular shapes. The geology of the summit is essentially constituted of granitic volcanic formations giving a ferruginous soil (Lamilen et al., 1998). They are characterised more or less by the abundance of fragments of deteriorating basalt (Geze, 1943).

The Kupe Mountain belongs to the bioclimatic zone of the mountains and high lands of West Cameroon within the submontane domain of the Guinean-Congolese phytogeographic region (Letouzey, 1968). Temperatures are curbed and thermal amplitudes are high (Melingui, 1989). The yearly average temperature is 20°C. The Kupe mountain is subjected to the humid wind (monsoon) coming from the Atlantic Ocean, and to the incursions of the tropical air of the Sahara (harmattan). The meeting of these two masses of air forms the Intertropical Front (ITF) whose swing determines the cycle of the seasons. The yearly rainfall varies from 73mm to 878mm (Fig. 2) with a yearly average of 4891mm. The climate is tropical, with 2 seasons: a dry season from November to April and a rainy season from May to October (Suchel, 1987). Relative humidity is very high on the mountain and reaches a mean of 87% (Tchiengué, 2004).

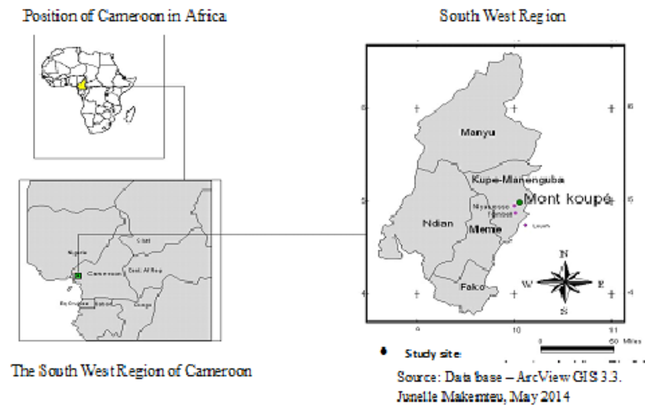

Fig. 1: Map of the location of Mount Kupe (Source: Makemteu, 2014).

Methodology

A quantitative inventory of 1ha surface area was achieved using a biplot of rectangular dimensions (25m by 40 m), taking into account all trees of which the DBH at 1.30cm above soil was ≥10cm. The plot was chosen from intact an portion representative of the forest. From the information gathered, we represented a diagram of the distribution of the diameters in classes (Noumi, 2012, 2013; Tchoua, 2013; Tagne, 2007) as well as the area-species curve (Gounot, 1969). Using the standard methodology (Curtis and Mcintosh, 1950; Dagnelie, 1981) the following parameters were calculated. At specific and family level: relative density and relative dominance; at specific level: relative frequency; at family level only: relative diversity. From these data importance value index (IVI) and Family importance value (FIV) were calculated for species and families, respectively. The basal area, that is, the sum of the area of each tree trunk, was measured at a definite height (Mori et al., 1983; Devineau, 1984; Senterre et al., 2001).

Sampling was conducted in a fractional manner in plots, all identical from the mesologic and physionomic point of view, between 2011 and 2014. The inventory was done and all trees and lianas with DBH ≥10cm were taken into acount. The determination of large tree which were inaccessible during data collection was made *in situ* using the dendrological criteria (Normand, 1965; Vivien and Faure, 1985). All of the 1184 samples harvested were pressed and dried in the Plant Biology Laboratory of the Higher Teacher's Training College of the

University of Yaounde 1 and the National Herbarium of Cameroon in Yaoundé. Trees were distributed according to classes of 10cm diameter; species classification in function of maximum diameter reach was made. The floristic diversity was considered in a synthetic manner through the main physionomic and phytogeographical spectres.

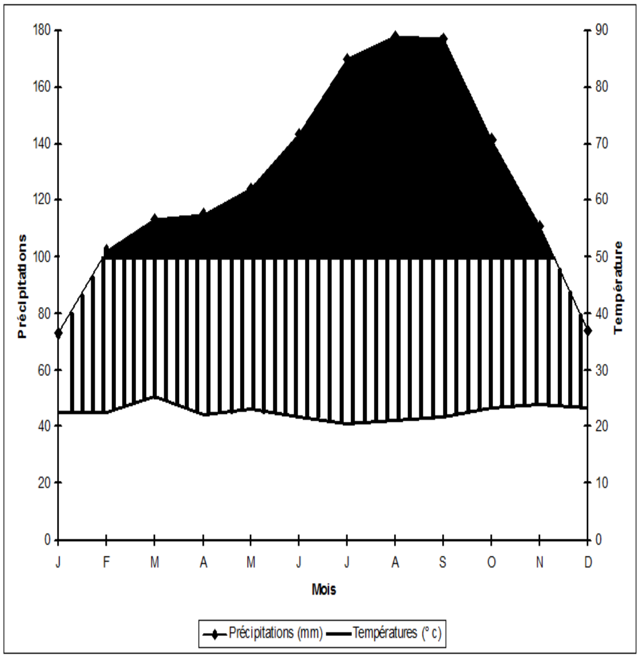

Fig. 2: Ombrothemic diagram. Curve of the monthly mean of rainfalls [scale reduced to the 1/10 from 100 mm, gray part according to the method of Walter and Leith (1964)] and of the monthly mean temperature. Data of the meteorological station of Tombel from 1987 to 1997. There are no monthly mean values of precipitation and temperature in Nyassosso, but these values must be nearest of those of Tombel station situated 25 km to the Southern side.

The Biological Types (BT) were distinguished according to the classification of Raunkiaer (1934), done by Schnell (1970). Their types of phytogeographical distribution (TP) were established according to the works of Schnell (1970) for the inter-tropical massif orophytes; according to the works of White (1983) for the big chorological subdivisions of Africa and that of Letouzey (1985) for the phytogeography of Cameroon. The altitude components of the species were established according to Senterre (2005): Bm = species of low and middle altitude; Sm = species of submontane forest or submontane floor; Mi = species of lower highland forest or lower highland floor or humid highland floor. The categories were deducted from the characteristics of the species. Only the intermediate combination between two successive types of the pressure gradient (none disconnected) was generally feasible. The combination of the phytogeographical distribution and the components elevation enabled an orophytic species to be better situated in different chorological area (Schnell, 1970; Noumi, 2012, 2013).

Floristic analysis

In order to compare the sample realised with the others studies, the following indices of diversity were calculated:

- Shannon and Weaver (1948) : ISH = $-\sum N_i/N \log_2 N_i/N$;
- Simpson homogeneity index (Colinveaux, 1986): $D' = (N_i/N)^2$;
- Pielou equitability (1966): EQ = $ISH/\log_2 S$.

Where: N_I is the strength of the species "I" and N the strength of all species. ISH is expressed in bits. S is the number of species present on the plots.

Results

Floristic composition

The floristic inventories carried out a 1ha plot in the Mount Kupe submontane forest resulted in a census of 1184 individuals (trees and lianas) at dbh ≥10cm representing 156 species regrouped into 114 genera and 51 families (Appendix 1). Only one species was determined at the family level.

The most diversified families were *Rubiaceae*, (17 species and 12 genera), *Euphorbiaceae* (12; 9), *Annonaceae* (11; 9) and *Sapindaceae* (9; 5) (Table 1). In general, this vegetation is dominated by shrubby species (74, at least 47%) and the treelike species (51, at least 32%). The proportion of shrub (20, at least 12%) was low and similar to that of creeper species (11, at least 7%). The species censused in this submontane vegetation were regrouped into five different biological types. The distribution of species number according to families showed an inverted "J" shaped curve (Fig. 3). The number of species inventoried by plots of 0.1ha varied from 25 to 42 with an average of 34 species per plot. The total basal area attained was 151.44 m²/ha. From the morphological point of view, the classification of species in function of diameter showed five categories (A, B, C, D, and E) of whole vertical strata. According to the individual diameter, the maximum dbh was 185cm, a value reached by only an individual (*Carapa procera*). 822 individuals representing 69.43% encountered in the inventory had a diameter between 10cm -30cm; 23.06% had diameter between 30cm - 70cm and 6.67% had diameter between 70cm -130cm. One of the lower proportion individuals representing 8.4% of the species inventoried had a large dbh (>130cm).

Table 1. Diversity of 51 families in function of species.

Families	N_G	N_E	Families	N_G	N_E	Families	N_G	N_E
Rubiaceae	12	17	*Simaroubaceae*	2	3	*Caricaceae*	1	1
Euphorbiaceae	9	12	*Vitaceae*	1	3	*Cecropiaceae*	1	1
Annonaceae	9	11	*Acanthaceae*	2	2	*Comariopsidaceae*	1	1
Sapindaceae	5	9	*Agavaceae*	1	2	*Cyatheaceae*	1	1
Moraceae	3	7	*Araliaceae*	2	2	*Lecythidaceae*	1	1
Anacadiaceae	3	6	*Celastraceae*	1	2	*Leeaceae*	1	1
Malvaceae	3	6	*Icacinaceae*	2	2	*Menispermaceae*	1	1
Leguminosae	5	5	*Melastomataceae*	1	2	*Octoknemaceae*	1	1
Clusiaceae	3	5	*Myristicaceae*	1	2	*Opiliaceae*	1	1
Meliaceae	4	5	*Myrtaceae*	2	2	*Passifloraceae*	1	1
Sapotaceae	3	5	*Ochnaceae*	2	2	*Peripiocaceae*	1	1
Rutaceae	3	4	*Olacaceae*	1	2	*Polygalaceae*	1	1
Apocynaceae	2	3	*Thymeliaceae*	2	2	*Rhamnaceae*	1	1
Combretaceae	1	3	*Alangiaceae*	1	1	*Rosaceae*	1	1
Flacourtiaceae	3	3	*Bignoniaceae*	1	1	*Tiliaceae*	1	1
Lauraceae	2	3	*Boraginaceae*	1	1	*Urticaceae*	1	1
Piperaceae	2	3	*Burseraceae*	1	1	*Violaceae*	1	1

N_G: Genera number; **N_E:** Species number.

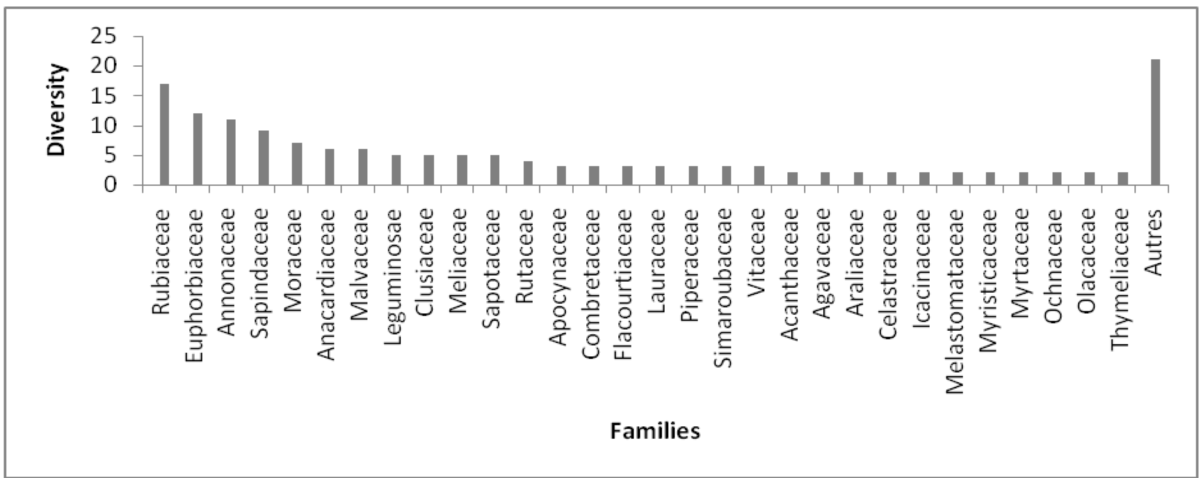

Fig. 3: Specific diversity of the families counted in the Mount Kupe submontane forest. The numbers of recorded species are indicated for every family.

Family level

Fifty-one families were registered in the sampling, taking the *Fabaceae*, *Caesalpiniaceae* and *Mimosaceae* as a single family (*Leguminosae*). The families with a higher relative dominance were *Meliaceae*, *Euphorbiaceae*, *Burseraceae*, *Malvaceae*, *Clusiaceae*, *Rubiaceae*, *Olacaceae*, *Myristicaceae*, *Moraceae* and *Apocynaceae*. Together, they represented 71.75% of the total basal area. From the relative density point of view, the ten most abundant families were *Meliaceae*, *Rubiaceae*, *Burseraceae*, *Menispermaceae*, *Malvaceae*, *Euphorbiaceae*, *Clusiaceae*, *Olacaceae*, *Anacardiaceae* and *Moraceae*. The densities of *Meliaceae*, *Rubiaceae*, *Burseraceae*, *Menispermaceae* and *Malvaceae* were >9% while those of *Euphorbiaceae*, *Clusiaceae*, *Olacaceae* and *Anacardiaceae* reached at least 7%. The *Rubiaceae* accounted for 10.89% of all the species.

The *Meliaceae*, *Rubiaceae*, *Burseraceae* and *Moraceae* were the most abundant with 50.93% of individuals censused in the sample. The relative diversity of

Rubiaceae (17 species) represents 10.89% of the total diversity of the sample. Twenty one families were represented by only one species, eleven by two species, seven by three species, one by four species and four by five species. The ten most important families for each of these relative parametres and the FIV are shown in Table 2. The values of the different parametres of these ten families with the highest family importance values (FIV) are presented in Fig. 4. The complete results for each of the families are given in Appendix 2.

Table 2. Families with the highest values of relative dominance, relative density, relative diversity and FIV in decreasing order.

Relative dominance	[x 100]	Relative Density	[x 100]	Relative diversity	[x 100]	FIV	[x 300]
Meliaceae	20.74	*Meliaceae*	17.27	*Rubiaceae*	10.89	*Meliaceae*	41.22
Euphorbiaceae	14.78	*Rubiaceae*	13.70	*Euphorbiaceae*	7.69	*Rubiaceae*	32.40
Burseraceae	10.61	*Burseraceae*	10.00	*Annonaceae*	7.05	*Euphorbiaceae*	30.94
Malvaceae	10.61	*Menispermaceae*	9.96	*Sapindaceae*	5.69	*Malvaceae*	23.55
Clusiaceae	9.65	*Malvaceae*	9.09	*Moraceae*	4.48	*Burseraceae*	21.25
Rubiaceae	7.81	*Euphorbiaceae*	8.47	*Anacardiaceae*	3.85	*Clusiaceae*	20.13
Olacaceae	6.98	*Clusiaceae*	7.27	*Malvaceae*	3.85	*Moraceae*	17.24
Myristicaceae	6.73	*Olacaceae*	7.27	*Leguminosae*	3.21	*Olacaceae*	15.53
Moraceae	6.40	*Anacardiaceae*	7.26	*Clusiaceae*	3.21	*Sapotaceae*	14.29
Apocynaceae	5.38	*Moraceae*	6.36	*Meliaceae*	3.21	*Menispermaceae*	13.78

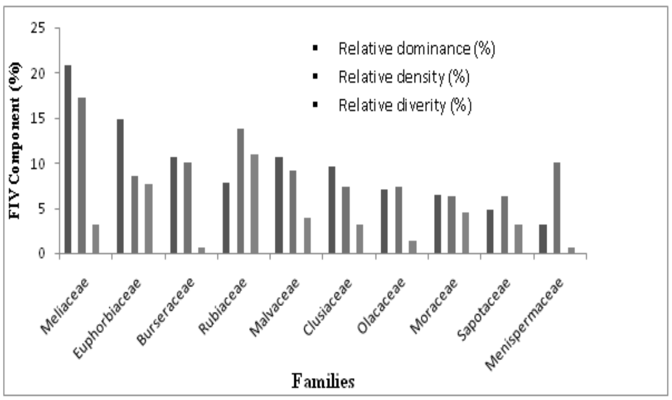

Fig. 4: Relative dominance, relative density and relative diversity of the ten most important families in FIV of the sample in 1ha of the Mount Kupe submontane forest.

When we compared the FIV and the three relative values of the ten most important families, only the *Clusiaceae*, *Euphorbiaceae*, *Malvaceae*, *Meliaceae*, *Moraceae* and *Rubiaceae* came among the first ten families for all these parametres. The *Menispermaceae* had a higher dominance while the *Burseraceae* had both a higher dominance and density; they were both represented by only one species each (*Penianthus longifolius* and *Santiria trimera respectively*). From the family importance value point of view, the *Meliaceae* were the most abundant with an FIV of 41.22%. They came first in relative density and dominance, and were 10th in relative diversity. The *Menispermaceae* were 11th in FIV due to their low relative diversities. The *Moraceae* were 5th in relative diversity but dropped to the 7th position in FIV because of their low relative dominance and density. The *Euphorbiaceae* were 6th in relative density but, rose to the 3rd position in FIV as a result of their higher relative dominance and diversity. The *Leguminosae* were 8th in relative diversity and 11th in relative dominance but, dropped to the 14th position in FIV because of their low relative density. The *Sapindaceae*, were 4th in relative diversity but did not come among the first ten in FIV value. They occupied the 13th position in FIV as a result of their low relative dominance and density.

Specific level

One hundred and fifty-six species were censused in an area of 1ha. The ten most abundant species for each of the parameter frequency, density and dominance were regrouped in Table 3. The complete result for each species is given in Appendix 3. The values of each of these parameters and the highest IVI (Importance Value Index) are represented in Fig. 5. Seven species representing 4.49% dominated the submontane forest and accounted for 34.30% of all the species censesed. A large number of species representing 69.23% was represented by six individuals; seventeen species were represented by two individuals; seventy species constituting 44.87% of total species censused were represented by one individual. From the point of view of dominance, *Santiria trimera* was 1st in relative dominance, but drops to the 4th position in relative density, while *Penianthus longifolius* which was 12th in relative dominance and was 1st in relative density. The species *Carapa procera* was 2nd in relative dominance, but, dropped to the 16th position in relative density. *Pycnanthus angolensis* was 4th in relative dominance but, found itself in the 21th position in relative density. *Cola acuminata* was 2th in relative frequency but, was 6th in relative density and 7th in relative dominance. A small propoertion (5.13%) of species accounted for 58.15% in relative dominance. The species *Santiria trimera*, *Carapa procera*, *Strombosia pustulata*, *Pycnanthus angolensis*, *Turraeanthus africanus*, *Macaranga occidentalis*, *Cola acuminata* and *Drypetes leonensis* had a relative dominance >5%. Attaining a higher dominance was restricted possibly by a high number of small individual or by a restricted number of large individual. The species *Santiria trimera* was 1st in IVI due to their high values in relative dominance and frequency. The species/area cumulative curve of this submontane forest is shown in Fig. 6. The shape of the curve is an indication that it is possible to determine a satisfactory sample on a 1ha plot on the Mount Kupe submontane forest. This curve shows a large specific richness of the forest studied.

Table 3. Species with the highest values of relative frequency, relative density, relative dominance and IVI in decreasing order.

Relative frequency	%	Relative Density	%	Relative Dominance	%	IVI	%
Carapa procera	7.59	*Penianthus longifolius*	9.96	*Santiria trimera*	10.61	*Santiria trimera*	19.64
Cola acuminata	6.33	*Sorindeia grandifolia*	5.07	*Carapa procera*	10.03	*Carapa procera*	19.31
Santiria trimera	5.06	*Psychotria sp. aff. Subobliqua*	4.05	*Strombosia pustulata*	6.98	*Cola acuminata*	15.56
Strombosia pustulata	3.80	*Santiria trimera*	3.97	*Pycnanthus angolensis*	6.73	*Penianthus longifolius*	14.72
Turraeanthus africanus	3.80	*Drypetes leonensis*	3.89	*Turraeanthus africanus*	6.69	*Drypetes leonensis*	13.01
Allanblackia gabonensis	3.80	*Cola acuminata*	3.72	*Macaranga occidentalis*	6.28	*Strombosia postulata*	12.30
Drypetes leonensis	3.80	*Strophanthus thollonii*	3.13	*Cola acuminata*	5.51	*Turraeanthus africanus*	11.58
Englerophytum stelechanthum	3.80	*Placodiscus opacus*	2.96	*Drypetes leonensis*	5.32	*Pycnanthus angolensis*	10.27
Trichilia rubescens	3.75	*Englerophytum stelechanthum*	2.79	*Allanblackia gabonensis*	3.91	*Englerophytum stelechanthum*	9.87
Pycnanthus angolensis	2.53	*Psychotria globosa*	2.45	*Englerophytum stelechanthum*	3.28	*Allanblackia gabonensis*	8.72

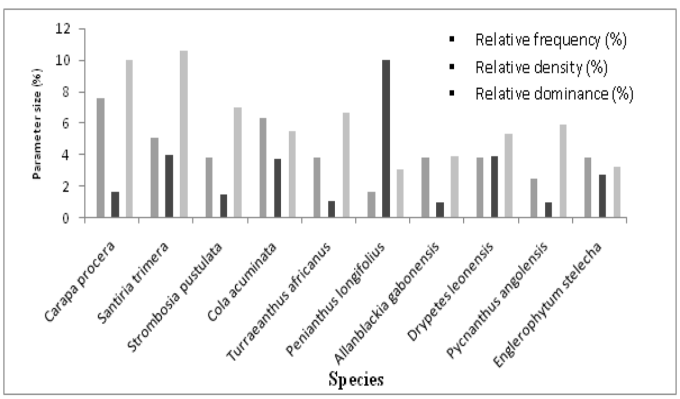

Fig. 5: Relative frequency, relative density and relative dominance of the ten most important species in IVI for 1 ha of the Mount Kupe submontane forest.

According to the phytogeographical affinity (Schnell, 1970; White, 1983; Senterre, 2005), the species of this submontane forest can subdivided into eight different groups of distribution: G (33.55), BG (18.06), At (17.42), CG (16.77), Ca (9.58), Aam (1.94), Am (1.29), Pal (1.29). 33.55% species are widely distributed in the Guineo-Congolese region in both of the major sub-regional centers (upper and lower Guineo-Congolese). 18.06% of the species are lower Guinean; 17.42% are distributed in tropical Africa; 16.77% are Centro-Guineo-Congolese; 9.68% are indicated in Cameroon exclusively. Many other species are shared by many distant domains: Aam (1.94%), Am (1.29%) and Pal (1.29%), thus, their populations are discontinuous. The species with wide phytogeographical distribution are few, those of transition are relatively numerous and the Guinean species are very well represented. The altitudinal variance of species is an important aspect of the Mount Kupe submontane forest that distinguishes it from the lowland forest (Appendix 1). It was found that the distribution of species according to the highland elevation patterns (Senterre, 2005; Noumi, 1998, 2012, 2013) is as follows: Lower and middle altitude floor (Bm and Bm + Sm) (33.97%), sub-mountain floor (Sm and Sm + Mi) (51.92%), lower mountain or humid mountain floor (Mi) (12.18%), species of wide spectre (1.29%). Details are shown in Appendix 4. The combination of geographical and elevation parametres to be determined should be such that it allows the redistribution of the species in different chorological areas (Schnell, 1970) throughout the world.

Discussion

Floristic composition - Family level

In the area sampled, more than 50.93% of all individuals were represented by four families. According to Rabevohitra et al. (1996) four, five or six families represent always more than 50 % of total trees in the littoral forest along Madagascar's coast. Table 4 shows that in the Mount Kupe submontane forest and in the samples from other submontane and montane forests in Cameroon, *Euphorbiaceae*, *Meliaceae* and *Rubiaceae* are frequently classed among the ten most abundant families. The *Menispermaceae* seemed to be the only numerically abundant family in the Mount Kupe submontane forest that do not occur in the first ten positions in lowland forests in Cameroon but, in submontane and montane forests. Family composition in lowland forests of the tropics tends to be similar (Gentry, 1988; Noumi, 2012, 2013). They listed eleven families (*Annonaceeae*, *Arecaceae*, *Bignoniaceae*, *Euphorbiaceae*, *Lauraceae*, *Leguminosae*, *Meliaceae*, *Moraceae*, *Myristicaceae*, *Rubiaceae* and *Sapotaceae*) that contribute to half of the species' richness in a 1ha sampling plot in lowland Neotropical forests. At least eight of these families are always among the ten richest species in Africa and Asia as well. This is not the case with the Mount Kupe submontane forest. Only four families (*Meliaceae*, *Rubiaceae*, *Burseraceae* and *Menispermaceae*) contribute to half of the species' richness in a 1ha sampling plot.

Table 4. The ten most abundant families in the Mount Kupe submontane forest compared to three Cameroonian highland forests.

Kala forest (Madiapevo, 2008) Alt. 1000-1156 m	Kouoghap sacrad forest (Noumi, 2012) Alt. 1400-1550 m	Manengouba forest (Noumi, 2013) Alt. 2200-2396 m	Kupe submontane forest (Present study) Alt. 1000-1800 m
Myristicaceae	*Rubiaceae*	*Myrsinaceae*	*Meliaceae*
Clusiaceae	*Meliaceae*	*Rubiaceae*	*Rubiaceae*
Leguminosae	*Moraceae*	*Euphorbiaceae*	*Burseraceae*
Annonaceae	*Bignoniaceae*	*Araliaceae*	*Menispermaceae*
Rubiaceae	*Apocynaceae*	*Meliaceae*	*Malvaceae*
Malvaceae	*Sapotaceae*	*Opiliaceae*	*Euphorbiaceae*
Meliaceae	*Leguminosae*	*Thymeliaceae*	*Clusiaceae*
Apocynaceae	*Euphorbiaceae*	*Cyatheaceae*	*Olacaceae*
Burseraceae	*Araliaceae*	*Rutaceae*	*Anacardiaceae*
Euphorbiaceae	*Clusiaceae*	*Rosaceae*	*Moraceae*

Among the aforementioned families, the *Meliaceae*, *Euphorbiaceae*, *Rubiaceae*, *Malvaceae*, *Clusiaceae* and *Moraceae* were among the ten important families in relative diversity and FIV in the surface sampled here (Table 5). It is remarkable that in Cameroon, *Leguminosae* also seem to be abundant in the submontane forests than in the Neotropical and African lowland forests. In the Kouoghap Sacrad forest (Noumi, 2012) they are second in FIV (FIV: 32.63), while in the Kala forest (Madiapevo, 2008) they are first out of 40 families, with an FIV value of 31.00. Similar abundance of *Leguminosae* in Cameroon was recorded by Tagne (2007) during the inventory of 1.25ha surface area in the submontane forest of Messa hill in Yaounde. Similar results were not obtained in the Mount Kupe submontane forest where they occupied the fourteenth position out of 51 families with an FIV of 12.53 (Tchoua, 2013). The scarcity of *Leguminosae* in the Mount Kupe submontane forest is worth noting. The same observation was made in the 1ha sampling plot of the Manengouba highland forest (Noumi, 2013). It is remarkable that in the Cameroonian submontane forests, the *Meliaceae* seemed to be more abundant than in the Neotropical and African lowland forests. In the Mount Kupe submontane forest it is first with an FIV accumulation value of 41.22; it is also first with an FIV of 33.38 in the Kouoghap Sacrad forest (Noumi, 2012); 8th with an FIV of 17.83 in the Kala forest (Madiapevo, 2008); 5th with an FIV of 17.26 in the Messa forest (Tagne, 2007); 5th with an FIV of 16.06 in the Manengouba forest (Noumi, 2013); and also 5th with an FIV of 18.70 in the Yapo forest (Corthay, 1996). The family composition of the Mount Kupe submontane forest tend to be similar to those of the lowland forest, but the relative abundance of the families of higher altitude – *Araliaceae*: 23th with an FIV of 4.01; *Agavaceae*: 34th with an FIV of 1.94; *Rosaceae*: 40th with an FIV of1.33 makes a distinction between the Mount Kupe submontane forest and the lowland forests. On the other hand in Cameroon, the *Rubiaceae* are much more abundant and more species-rich in the highland forests (Tagne, 2007; Madiapevo, 2008; Noumi, 2012, 2013). In the Mount Kupe submontane forest, the *Meliaceae* are much more abundant, the *Euphorbiaceae* and *Meliaceae* are much more dominant, with the *Rubiaceae* and *Euphorbiaceae* being the most diversified.

Table 5. Family importance value of 15 most abundant plant families in the Mount Kupe sub mountain forest and 4 other Cameroonian highland forests, and 5 lowland tropical forests as reported by D'Amico and Gautier (2000).

Kupe forest (Cameroon) Present study		Manengouba forest (Cameroon) Noumi (2013)		Kouoghap Sacrad forest (Cameroon) Noumi (2012)		Kala forest (Cameroon) Madiapevo (2008)		Messa forest (Cameroon), Tagne (2007)	
Families	**FIV**	**Families**	**FIV**	**Families**	**FIV**	**Families**	**FIV**	**Families**	**FIV**
Meliaceae	41.22	*Rubiaceae*	56.19	*Meliaceae*	33.38	*Leguminosae*	31.00	*Leguminosae*	47.60
Rubiaceae	32.40	*Euphorbiaceae*	55.71	*Leguminosae*	32.63	*Clusiaceae*	27.90	*Malvaceae*	33.17
Euphorbiaceae	30.94	*Araliaceae*	51.03	*Moraceae*	31.81	*Myristicacaeae*	26.80	*Moraceae*	28.93
Malvaceae	23.55	*Myrsinaceae*	49.52	*Sapotaceae*	26.83	*Burseraceae*	21.77	*Euphorbiaceae*	26.11
Burseraceae	21.25	*Meliaceae*	16.06	*Rubiaceae*	26.12	*Malvaceae*	21.41	*Meliaceae*	17.26
Clusiaceae	20.13	*Moraceae*	8.33	*Bignoniaceae*	21.16	*Annonaceae*	18.24	*Apocynaceae*	13.90
Moraceae	17.24	*Rutaceae*	7.95	*Apocynaceae*	19.49	*Rubiaceae*	17.96	*Myristicaceae*	12.59
Anacardiaceae	15.57	*Cyatheaceae*	7.40	*Euphorbiaceae*	15.74	*Meliaceae*	17.83	*Ulmaceae*	12.26
Olacaceae	15.53	*Opiliaceae*	6.66	*Verbenaceae*	12.51	*Euphorbiaceae*	15.78	*Caricaceae*	10.57
Sapotaceae	14.29	*Sapindaceae*	6.19	*Annonaceae*	11.23	*Apocynaceae*	13.76	*Rubiaceae*	10.12
Menispermaceae	13.78	*Thymeliaceae*	5.59	*Burseraceae*	9.65	*Irvingiaceae*	8.18	*Bombacaceae*	7.44
Annonaceae	13.05	*Rosaceae*	5.14	*Malvaceae*	9.33	*Moraceae*	8.13	*Cecropiaceae*	7.38
Sapindaceae	12.80	*Melianthaceae*	4.26	*Araliaceae*	7.70	*Cecropiaceae*	7.92	*Combretaceae*	7.37
Leguminosae	12.53	*Asteraceae*	3.14	*Agavaceae*	6.83	*Flacourtiaceae*	7.43	*Lauraceae*	7.19
Apocynaceae	12.14	*Alangiaceae*	3.10	*Clusiaceae*	6.66	*Sapotaceae*	7.38	*Olacaceae*	6.85
Yapo (Ivory Coast) Corthay (1996)		**Manongarivo (Madagascar) D'Amigo and Gautier (2000)**		**Alto Parana (Paraguay) Spichiger et al. (1992)**		**Yasuni (Ecuador) Balslev et al. (1987)**		**Jenera Herrera (Peru) Spichiger et al. (1996)**	
Families	**FIV**	**Families**	**FIV**	**Families**	**FIV**	**Families**	**FIV**	**Families**	**FIV**
Sapotaceae	34.15	*Clusiaceae*	40.78	*Meliaceae*	44.40	*Arecaceae*	55.66	*Leguminosae*	29.07
Leguminosae	32.27	*Euphorbiaceae*	29.09	*Lauraceae*	42.40	*Moraceae*	36.48	*Sapotaceae*	28.22
Burseraceae	24.83	*Myrtaceae*	27.17	*Sapotaceae*	39.40	*Leguminosae*	23.73	*Moraceae*	23.50
Euphorbiaceae	18.88	*Rubiaceae*	21.23	*Leguminosae*	31.90	*Bombacaceae*	19.66	*Myristicaceae*	18.84
Meliaceae	18.70	*Myristicaceae*	19.04	*Rutaceae*	25.40	*Myristicaceae*	19.59	*Lauraceae*	18.28
Malvaceae	18.57	*Lauraceae*	16.32	*Moraceae*	20.40	*Rubiaceae*	14.73	*Chrysobalanaceae*	18.05
Ebenaceae	15.49	*Burseraceae*	13.77	*Boraginaceae*	14.70	*Meliaceae*	11.62	*Lecythidaceae*	17.38
Clusiaceae	14.85	*Sapotaceae*	10.48	*Arecaceae*	11.10	*Euphorbiaceae*	8.15	*Burseraceae*	11.84
Olacaceae	13.51	*Erythroxylaceae*	9.51	*Annonaceae*	10.10	*Cecropiaceae*	7.86	*Annonaceae*	10.67
Chrysobalanaceae	12.08	*Annonaceae*	9.37	*Bignoniaceae*	8.20	*Lecythidaceae*	7.54	*Arecaceae*	9.47
Flacourtiaceae	11.91	*Sarcolaenaceae*	8.27	*Solanaceae*	4.60	*Lauraceae*	7.37	*Vochysiaceae*	9.43
Combretaceae	8.75	*Asteraceae*	8.22	*Myrtaceae*	3.50	*Malvaceae*	6.72	*Humiraceae*	8.52
Lecythidaceae	6.64	*Leguminosae*	7.71	*Sapindaceae*	3.20	*Flacourtiaceae*	6.18	*Cecropiaceae*	7.89
Irvingiaceae	6.37	*Ebenaceae*	7.57	*Flacourtiaceae*	2.70	*Polygonaceae*	6.07	*Rubiaceae*	7.79
Scytopetalaceae	6.35	*Arecaceae*	7.17	*Euphorbiaceae*	2.50	*Sapotaceae*	5.59	*Combretaceae*	7.50

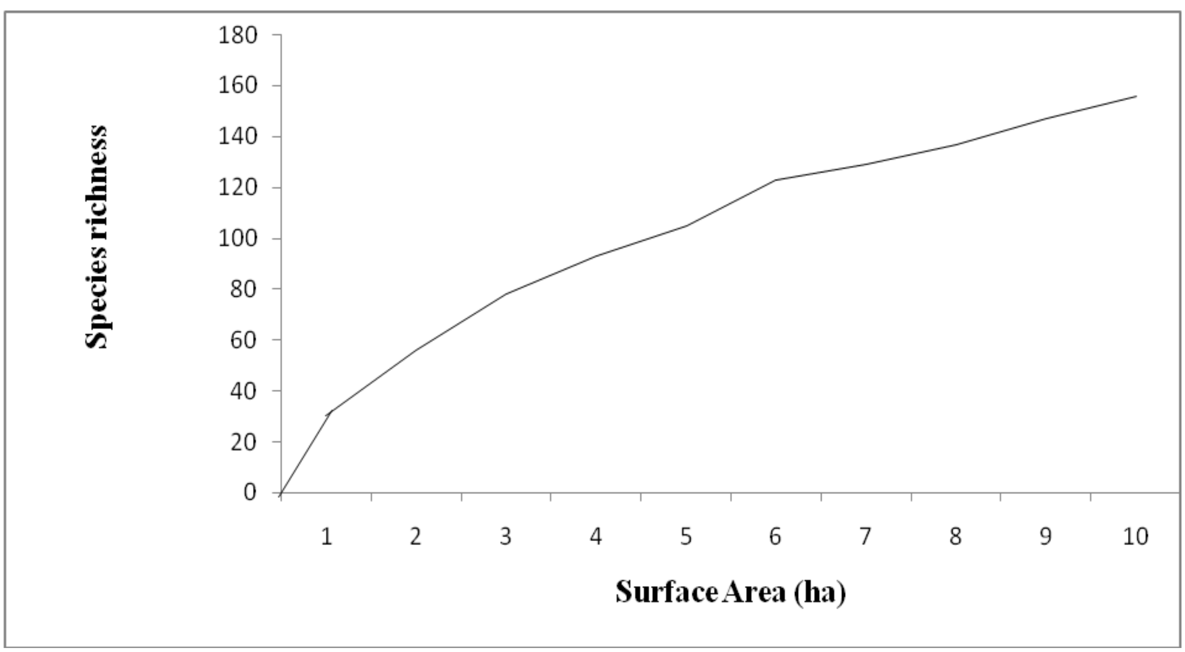

Fig. 6: Species/area cumulative curve of the 1ha sampling plot in the Mount Kupe sub mountain forest (for ligneous flora with dbh ≥ 10cm). Each sub-unit is represented by a surface area of 40cm by 25cm.

Specific level

In this inventory, one hundred and fifty-six (156) pecies were met in a 1ha sampling plot. In the other Cameroonian highland forests, this number seems to fluctuate within a sampling area of 1ha estimated by the same method (Kala, 178 species/ha; Messa, 151 species/ha; Kouoghap Sacrad forest, 79 species/ha; Manengouba, 40 species/ha). This variation is similar in other countries of tropical Africa ranging between 40 and 178 (Table 6). In Madagascar, it is 38 – 146 (Rabevohitra et al., 1996). In the Neotropical region, it is 228 in the Amazonian forest of Ecuador (Balslev et al., 1987). Low values of diversity have been registered in Ivory Coast where Corthay (1996) found 76 and 77 species/ha in two plots of the classified forest of Yapo and in Alto Parana where Spichiger et al. (1992) found 60 species/ha. The Mount Kupe submontane forest (156 species/ha) is characterized by the highest value of the species number per hectare registered by different studies in the African, Malagasy and Neotropical forests. The selective conditions of the mesological factors in the submontane zone considerably increase the number of species contrary to those of the Manengouba highland.

Table 6. Number of species per/ha and Shannon diversity index of the Guinean - Congolese rainforests, in order of decreasing density.

Name of the forest	Countries	Authors	No. of Species/ha	Shannon's Diversity Index
Kala forest	Cameroon	Madiapevo (2008)	178	5.19
Kupe forest	Cameroon	Tchoua (2013)	156	5.86
Messa forest	Cameroon	Tagne (2007)	151	6.24
Dja Biosphere Reserve forest	Cameroon	Sonké (1998)	138	5.62
Lopé forest	Gabon	White (1992)	129	4.14
Kouoghap Sacrad forest	Cameroon	Noumi (2012)	79	4.83
Yapo forest	Côte d'Ivoire	Corthay (1996)	77	6.19
Ngotto forest	République Centrafricaine	Lejoly (1995)	58	5.30
Cleistopholis patens and *Ficus mucusoforest*	Benin	Sokpon (1995)	53	4.76
Manengouba forest	Cameroon	Noumi (2013)	40	3.98

According to Rollet (1983), 50% of individuals on average are represented by twenty species in the undisturbed lowland Amazonian forest of Venezuela. In the Mount Kupe submontane forest, half of all individuals are represented by only fourteen species. Similar values were found in the Messa forest (17 species) (Tagne, 2007); Kala forest (7 species) (Madiapevo, 2008); Kouoghap Sacrad forest (5 species); Manengouba forest (4 species) all in Cameroon (Noumi, 2012, 2013); and in the Manongarivo forest (11 species) were classed by D'Amico and Gautier, 2000). Only four of these species were classed among the ten most abundant families in terms of their FIV values as a result of their relative densities. The individuals/species ratio in the Mount Kupe sampling plot is 7.59 (Tchoua, 2013). Other studies in Cameroon, recorded values of 33.4 (Noumi, 2012); 19.13 (Noumi and Kitio, 2013); 10.57 (Madiapevo, 2008); and 8.03 (Tagne, 2007). Other ratios have been found for the tropical regions and Malagasy: 22.1 (Rabevohitra et al., 1996); 8.1 (D'Amico and Gautier, 2000); 7.96 and 8.42 (Corthay, 1996). A series of 1ha forest inventory samples in the Neotropics recorded the following values: 7.37 in Paraguay (Spichiger et al., 1992); 2.79 in Ecuador (Balslev et al., 1987). The exaggerated gregariousness of some species in the Mount Kupe submontane forest is therefore brought to the fore from 1600m of altitude.

The Shannon diversity index (ISH) (Shannon and Weaver, 1949) enables a good appreciation of the diversity on the different plots because it takes into account the number of species and the abundance in distribution. Its calculated values for different Guinean forests are between 4 and 6.5. The Mount Kupe formations presents a higher Shanon index value (IHS = 5.86), which shows a better diversified forest, with gregarious species (Table 6).

Mori et *al*. (1983) considered species found only once in the sample as rare. In the Kouoghap Sacrad forest of Western Cameroon, 32.5% (Noumi, 2012) of species were rare, according to this definition. An inventory in the Messa forest (Tagne, 2007) recorded a value of 28%. In this study, the percentage of species represented by only one individual (44.87%) is higher than those found in the above mentioned studies and is close to the value found in Eastern Brazil 41.0% (Mori et *al*., 1983), but is higher than 22% (Spichiger et *al*, 1992) as in the Alto Parana; 21.0% (D'Amico and Gautier, 2000) in Manongarivo and 12.5% (Madiapevo, 2008) in Kala.

The IVI of *Santiria trimera*, the species with the highest in the plot, is 19.64. This species is not present in the Manengouba highland vegetation (Noumi, 2013); the vegetation of Kouoghap Sacrad forest (Noumi, 2012), the Mount Kala submontane vegetation (Madiapevo, 2008), and the Messa hill (Tagne, 2007).

The floristic composition of the Mount Kupe submontane forest matches up, according to the parametres under consideration in this study, with some lowland forests. However, there are some discrepancies that could be explained by altitude. In the Mount Kupe submontane forest, as well as in other forests with an elevation above 1000m, the species (and other main ones) with the highest IVI is a submontane species: *Santiria trimera*, *Burseraceae*. (*Syncepalum cerasiferum*, *Sapotaceae* in the Kouoghap Sacrad forest; *Allanblackia gabonensis*, *Clusiaceae* in the Kala forest; *Cylicomorpha solmsii*, *Caricaceae* in the Messa forest; or a highland species: *Macaranga occidentalis*, *Euphorbiaceae* in the Manengouba highland forest. Furthermore, the presence of *Alangiaceae*, *Araliaceae* and *Clusiaceae* clearly corresponds to the typical submontane forest constituted by the Mount Kupe formation.

The phytogeographic affinities: According to White (1983) the Cameroonian submontane forests form an archipelago connected comfortably, from the floristic point of view, to the other African highland archipelagos. The phytogeographical affinities of the mountain species recorded here falls within many distribution patterns.

Size of plant species: 78.06% of total species are widely distributed in the Guinean-Congolese regional forest; among which are: *Alangium chinense* with a paleotropical distribution (Jacques-Felix, 1970). *Prunus africana* is the species distributed throughout three African archipelagos (Cameroonian Afro-highland archipelago, East and South African highland archipelagos). *Allophylus bullatus* is endemic to the Cameroonian highland archipelago.

The altitudinal affinities: Comparing floristic composition of the Mount Kupe submontane forest and other highland rainforests sampled in Cameroon (Letouzey, 1985), 59 (37.82%) species are shared with submontane vegetation; 31 (19.87%) species in the lowland vegetation and submontane forests; 22 (14.10%) species in the lowland vegetation; 22 (14.10%) species in the submontane and lower montane vegetation; and 19 (12.18%) species in the lower montane vegetation. They are: (*Alangium chinense*, *Cissus amoena*, *Crotonogyne preussii*, *Cryptolepis sanguinolenta*, *Cyathea camerouniana*, *Dracaena sp. aff. phrynioides*, *Erythrococca anomala*, *kigelia africana*, *Monodora myristica*, *Octoknema genovefae*, *Peperomia pallucida*, *Piper umbellatum*, *Psychotria gabonica*, *Psychotria succulenta*, *Rutidea glabra*, *Salacia loloensis*, *Sorindeia winkleri*, *Tarrena eketensis*, *Urera repens*); 2 (1.29%) species have a wide distribution. A total of 1184 individuals belonging to 156 species, 114 genera and 51 families were recorded. They reached a total basal area of 151.44 m²/ha.

Conclusion

The present work is spread out upon the whole submontane area covered by the Mount Kupe forest. There is a very marked qualitative difference judging from the abundance of the *Leguminosae* family in the lowland forests and rarity in the Mount Kupe submontane forest. The *Leguminosae* families which dominate in the lowland forests do not occur among the ten most abundant families in terms of their FIV; they rather come in the 14th position. Here, the *Rubiaceae* families mark the submontane storey by their diversity and their second position in terms of their FIV.

From the quantitative point of view, the *Penianthus longifolius* species are very rare in the lowland forests but mark the Mount Kupe submontane forest by its abundance and 4th position in IVI. In conclusion, the Mount Kupe submontane forest distinguishes itself substantially from the lowland forests. Floristic affinities of the species show that more than twenty-five species are orophytes amongst which some are widely distributed in the Guinean-Congolese region, whereas others are shared with the East and South African archipelagos.

Conflict of interest statement

Authors declare that they have no conflict of interest.

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List of Appendices

Appendix 1. **Floristic list of the Mount Kupe submontane forest, with the number of individual by class average of diameter encountered on 10 sampling plots. TP : Phytogeographic type; TB : Biologic type; TF : Leaf dimension type; TD : Spore type; TH : Steep type.**

Appendix 2. **The 51 families with their values of relative dominance, relative density, relative diversity and FIV in decreasing order.**

Appendix 3. **The 156 species with their basal areas; their relative frequency, relative density, relative dominance and IVI in decreasing order.**

Appendix 4. **Rough and balanced spectres of phytogéographic type (TP), biologic type (TB), leaf types (TF), spore type (TD) and steep type (TH) of the species recorded in Mount Kupe submontane forest.**

Appendix 1. Floristic list of the Mount Kupe submontane forest, with the number of individual by class average of diameter encountered on 10 sampling plots. TP : Phytogeographic type; TB : Biologic type; TF : Leaf dimension type; TD : Spore type; TH : Steep type.

							Plots										Average class of diameter																			
TP	TB	TF	TD	TH	Families	Species	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	D15	D25	D35	D45	D55	D65	D75	D85	D95	D105	D115	D125	D135	D145	D155	D165	D175	D185	Effective
At	NnPh	Micro	Sarco	sm	*Leguminosae*	*Adenocarpus mannii* (Hook.f.) Hook. f.						1					1																		1
Pal	McPh	Macro	Baro	mi	*Alangiaceae*	*Alangium chinense* (Lour.) Harms		1																					1						1
GC	MsPh	Méso	Ballo	bm + sm	*Euphorbiaceae*	*Alchornea floribunda* Müll. Arg.	8			1		7					15	1																	16
At	McPh	Micro	Ballo	bm	*Euphorbiaceae*	*Alchornea hirtella* *Benth.fa.glabata* (Müll. Arg.) Pax & K. Hoffm.	2											1		1															2
CG	MsPh	Micro	Sarco	bm + sm	*Clusiaceae*	*Allanblackia floribunda* Oliv.	7	2	3								1			3			3	2	2	1									12
G	McPh	Méso	Scléro	sm	*Sapindaceae*	*Allophylus africanus* P. Beauv. *Var.*africanus						1						1																	1
Ca	McPh	Méso	Scléro	sm + mi	*Sapindaceae*	*Allophylus bullatus* Radlk.									1	2	2	1																	3
BG	McPh	Méso	Scléro	sm	*Sapindaceae*	*Allophylus grandifolius* (Baker) Radlk.					1						1																		1
G	MsPh	Méso	Sarco	bm + sm	*Sapotaceae*	*Aningeria robusta* (A. Chev.) Aubrév. & Pellegr.		1										1																	1
GC	MsPh	Macro	Sarco	bm	*Annonaceae*	*Anonidium mannii* (Oliv.) Engl.& Diels				2								1						1											2
At	MgPh	Macro	Ballo	bm	*Moraceae*	*Antiaris toxicaria var.welwitschii* (Engl.)C.C.Berg.					1															1									1
GC	McPh	Méso	Sarco	sm	*Euphorbiaceae*	*Antidesma laciniantum* Müll.Arg. *var. laciniantum*					1									1															1
CG	McPh	Méso	Sarco	sm	*Euphorbiaceae*	*Antidesma vogelianum* Müll. Arg.						2					2																		2
CG	Phgr	Méso	Sarco	sm	*Annonaceae*	*Artabotrys congolensis* De Wild & T. Durand					1						1																		1
BG	McPh	Micro	Sarco	sm	*Passifloraceae*	*Barteria solida* Breteler			2	1							3																		3
BG	McPh	Micro	Sarco	sm	*Lauraceae*	*Beilschmiedia acuta* Kosterm.			9								3		2	2			1	1											9
Ca	McPh	Méso	Sarco	bm + sm	*Lauraceae*	*Beilschmiedia crassipes* &Wilezek(Engl. & K. Krause) Robyns& Wilezek	3	1								1	3	4	2	2						2									13
CG	McPh	Méso	Sarco	sm	*Comariopsidaceae*	*Bolbitis gaboonensis* (Hook.)Alston					1						1																		1
G	McPh	Méso	Sarco	sm	*Simaroubaceae*	*Brucea guineensis* G. Don			1		2						2	1																	3

TP	TB	TF	TD	TH	Families	Species	Plots										Average class of diameter																		
							R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	D15	D25	D35	D45	D55	D65	D75	D85	D95	D105	D115	D125	D135	D145	D155	D165	D175	D185	Effective
BG	MsPh	Méso	Sarco	bm + sm	*Flacourtiaceae*	*Caloncoba glauca* (P. Beauv.) Gilg		1										1																	1
BG	McPh	Macro	Sarco	bm	*Ochnaceae*	*Campylospermum elongatum* (Oliv.) Tiegh.				1							1																		1
CG	NnPh	Méso	Sarco	sm	*Rubiaceae*	*Canthium vulgare* (K. Schum.)Bullock						6					9																		9
Aam	MsPh	Méso	Sarco	bm + sm	*Meliaceae*	*Carapa procera*.D C				1		10		2	1	3	6	1	1	2		1	2	1	1	1	1		1	1				1	20
GC	McPh	Micro	Sarco	sm	*Polygalaceae*	*Carpolobia alba* G. Don			1											1															1
GC	MsPh	Macro	Sarco	bm	*Sapotaceae*	*Chrysophyllum africanum* A. DC.				1															1										1
CG	MsPh	Méso	Sarco	bm + sm	*Sapotaceae*	*Chrysophyllum lacourtianum* De Wild.		1	1						1	1		2		1					1										4
GC	Phgr	Méso	Sarco	sm	*Sapotaceae*	*Chrysophyllum welwitschii* Engl.						1								1		1													2
BG	NnPh	Micro	Sarco	mi	*Vitaceae*	*Cissus amoena* Gilg & Brandt										2	1	1																	2
At	NnPh	Micro	Sarco	bm + sm	*Vitaceae*	*Cissus aralioides* (Welw.ex Baker) Planch				1									1																1
CG	NnPh	Micro	Sarco	sm	*Vitaceae*	*Cissus barbeyana* De Wild. & T. Durand								1					1																1
At	McPh	Méso	Sarco	sm + mi	*Rutaceae*	*Clausena anisata* (Willd.) Hook. f. ex Benth						1						1																	1
GC	MsPh	Méso	Sarco	bm	*Annonaceae*	*Cleistopholis patens.* (Benth.)Engl & Diels			1														1												1
CG	MsPh	Méso	Sarco	bm	*Myristicaceae*	*Coelocaryon preussii* Warb.				1												1													1
Ca	NnPh	Micro	Sarco	sm	*Rubiaceae*	*Coffea bakossii* Cheek & Bridson								2			1		2																3
Ca	NnPh	Micro	Sarco	sm	*Rubiaceae*	*Coffea montekupensis* Stoffelen													1																1
G	MsPh	Méso	Sarco	sm + mi	*Malvaceae*	*Cola acuminata* (P.Beau.) Schott et Endl	1	3		1	1	1		7	5	8	14	8	6	5	2	2	3		1	2		1							44
BG	McPh	Méso	Sarco	bm + sm	*Malvaceae*	*Cola cauliflora* Mast.	1	3		1							3	1		1															5
CG	MsPh	Méso	Sarco	bm + sm	*Malvaceae*	*Cola grandifolia*	25	1	1		1						8	10	3	2	1	2	1			1									28
Aam	MsPh	Méso	Sarco	sm	*Malvaceae*	*Cola verticillata* (Thonn.) Stapf ex A. Chev.				1															1										1
	Phgr			sm	*Combretaceae*	*Combretaceae liane*	6	9									7	6	2																15
GC	Phgr	Nano	Scléro	bm + sm	*Combretaceae*	*Combretum bracteatum* (M. A. Lawson) Engl. & Diels				3		1		5			11	7	1																19
At	Phgr	Nano	Scléro	sm + mi	*Combretaceae*	*Combretum paniculatum* Vent.								7	3	2	9	1	2																12

TP	TB	TF	TD	TH	Families	Species	Plots										Average class of diameter																		
							R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	D15	D25	D35	D45	D55	D65	D75	D85	D95	D105	D115	D125	D135	D145	D155	D165	D175	D185	Effective
BG	McPh	Méso	Sarco	sm	*Boraginaceae*	*Cordia aurantiaca* Bak.			1											1															1
BG	McPh	Macro	Sarco	sm	*Lecythidaceae*	*Crateranthus talbotii*Bak. F.					2							1	1																2
BG	McPh	Micro	Pogo	mi	*Euphorbiaceae*	*Crotonogyne preussii*Pax									1												1								1
At	Phgr	Micro	Pogo	mi	*Periplocaceae*	*Cryptolepis sanguinolenta* (Lindl.) Schltr.										1			1																1
BG	McPh	Méso	Sarco	sm	*Rubiaceae*	*Cuviera longiflora* Hierns			1									1																	1
Ca	NnPh	Lepto	Scléro	mi	*Cyatheaceae*	*Cyathea camerooniana* Hook.var.zenkeri (Diels) Tardieu									2			1	1																2
Ca	MsPh	Méga	Sarco	sm	*Caricaceae*	*Cylicomorpha somlii* (Urb.) Urb.	1			1		2		1				1		1			2		1										5
At	MsPh	Méso	Sarco	bm + sm	*Leguminosae*	*Daniellia oliveri* (Rolfe) Hutch. & Dalziel		1																	1										1
GC	McPh	Méso	Scléro	sm	*Sapindaceae*	*Deinbollia sp. aff. maxima* Gilg		1									1																		1
CG	McPh	Méso	Scléro	sm	*Sapindaceae*	*Deinbollia rambaensis* Pellegr.		1										1																	1
GC	McPh	Méso	Baro	bm + sm	*Tiliaceae*	*Desplatsia dewevrei* (De Wild. & T. Durand)	1	3		1							3	1	1																5
Ca	NnPh	Micro	Sarco	sm + mi	*Thymeliaceae*	*Dicranolepis vestita* Engl.						2		10	3	7	8	9	3	1		1													22
At	NnPh	Micro	Sarco	sm	*Agavaceae*	*Dracaena fragrans* (L.) Ker-Gawl.								1			3																		3
G	NnPh	Micro	Sarco	mi	*Agavaceae*	*Dracaena sp. aff. Phrynioides* Hook.									1	1	1		1																2
G	MsPh	Méso	Sarco	Large	*Euphorbiaceae*	*Drypetes leonensis* Pax	2	6	12	3	10	2		1	1	7	19	10	3	4	3	2	2		1		1				1				46
BG	MsPh	Méso	Sarco	sm + mi	*Euphorbiaceae*	*Drypetes preussii* (Pax) Hutch.		5	1		3	3		2	1		8		2	1		1	1	1								1			15
BG	McPh	Méso	Sarco	bm + sm	*Sapotaceae*	*Englerophytum stelechanthum* KK. Krause	1	3	22		7						14	4	2	4	2		2	2	2	1									33
GC	MsPh	Méso	Sarco	sm + mi	*Meliaceae*	*Entandrophragma angolense* (Welw.) C.CD.					1	1				1	3	1																	4
GC	MsPh	Méso	Sarco	sm	*Fabaceae*	*Erythrina mildbraedii* Harms		1																1											1
G	McPh	Micro	Sarco	mi	*Euphorbiaceae*	*Erythrococca anomala* (Juss. Ex Poir.) Prain										1	1																		1
GC	McPh	Méso	Sarco	bm + sm	*Myrtaceae*	*Eugenia obanensis* Bak.f.	2	1	9	4	9			1		1	7	8	7	2	2		1												27
Pal	MsPh	Méso	Sarco	bm	*Moraceae*	*Ficus exasperata* Vahl.						1							1																1
GC	MgPh	Méso	Sarco	bm	*Moraceae*	*Ficus mucuso* Welw.*ex* Ficalho						4					2	1								1									4

TP	TB	TF	TD	TH	Families	Species	Plots										Average class of diameter																		
							R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	D15	D25	D35	D45	D55	D65	D75	D85	D95	D105	D115	D125	D135	D145	D155	D165	D175	D185	Effective
CG	MsPh	Micro	Sarco	bm + sm	*Moraceae*	*Ficus ottoniifolia* (Miq.) Miq.subsp. Ottoniifolia									1											1									1
At	MsPh	Méso	Sarco	sm + mi	*Moraceae*	*Ficus sur* Forssk.			1	1		4			2	1	3	1				1	1			1		2							9
At	MsPh	Micro	Sarco	bm + sm	*Moraceae*	*Ficus trichopoda* Baker						1						1																	1
BG	McPh	Méso	Sarco	sm	*Clusiaceae*	*Garcinia lucida* Vesque				21							2	7	3	4	3	1	1												21
BG	McPh	Méso	Sarco	sm + mi	*Clusiaceae*	*Garcinia mannii* Oliv.		1	1			1			1	1	5				1														6
GC	McPh	Méso	Sarco	sm + mi	*Clusiaceae*	*Garcinia smeathmannii* (Planch.& Triana) Oliv.			1		2				1	7	1	1	1	1	4	2			1										11
GC	McPh	Méso	Sarco	bm	*Rubiaceae*	*Gardenia vogelii* Hook. f.ex Planch.	1										1																		1
GC	MsPh	Méso	Sarco	sm	*Flacourtiaceae*	*Homalium africanum* (Hook. f) Benth.					1									1															1
BG	McPh	Méso	Sarco	bm	*Lauraceae*	*Hypodaphnis zenkeri* (Engl.) Stapf						1												1											1
GC	NnPh	Micro	Sarco	sm	*Icacinaceae*	*Icacina mannii* Oliv.				1								1																	1
BG	McPh	Méso	Scléro	sm	*Sapindaceae*	*Eriocoelum petiolare* Radlk.								1										1											1
G	McPh	Méso	Scléro	bm	*Sapindaceae*	*Eriocoelum racemosum* Baker	1										1																		1
BG	McPh	Méso	Sarco	sm	*Annonaceae*	*Isolona zenkeri* Engl.						2					2																		2
CG	NnPh	Méso	Sarco	sm	*Rubiaceae*	*Ixora guineensis* Benth.		1		2	1						5	2	1																8
At	McPh	Méso	Pogo	mi	*Bignoniaceae*	*kigelia africana* (Lam.) Benth.										7	1	2	4																7
CG	MsPh	Méso	Sarco	bm	*Euphorbiaceae*	*Klaineanthus gaboniae* Pierre ex Prain					1														1										1
BG	McPh	Méso	Sarco	sm + mi	*Sapindaceae*	*Laccodiscus ferrugineus* (Baker) Radlk.			2		1					3	2	3	1			1													7
GC	MsPh	Méso	Sarco	bm	*Anacardiaceae*	*Lannea welwitschii* (Hiern) Engl.						1					1																		1
CG	Nnph	Micro	Sarco	sm	*Icacinaceae*	*Lasianthera africana* P. Beauv.				2							2																		2
At	McPh	Micro	Sarco	sm + mi	*Leeaceae*	*Leea guineensis* G. Don						3				2	6	1																	7
Ca	McPh	Méso	Sarco	bm + sm	*Malvaceae*	*Leptonychia pallida* K. Schum.	1	3		1							5																		5
Ca	MsPh	Méso	Sarco	bm + sm	*Euphorbiaceae*	*Macaranga occidentalis* (Müll. Arg.) Müll.Arg.	1					8					2	3	2	1	1	2													11
GC	MsPh	Méso	Sarco	bm	*Rhamnaceae*	*Maesopsis eminii* Engl.	1																	1											1
AM	McPh	Micro	Sarco	bm	*Euphorbiaceae*	*Mallotus oppositifolius* (Geisel.) Müll. Arg.		1										1																	1

							Plots										Average class of diameter																		
TP	TB	TF	TD	TH	Families	Species	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	D15	D25	D35	D45	D55	D65	D75	D85	D95	D105	D115	D125	D135	D145	D155	D165	D175	D185	Effective
GC	MsPh	Méso	Sarco	bm	*Clusiaceae*	*Mammea africana* Sabine	2										1	1																	2
Ca	McPh	Méso	Sarco	sm	*Melastomataceae*	*Memecylon dasyanthum* Gilg & Ledermann ex Engl.			2	1	2						3	1			1														5
Ca	McPh	Micro	Sarco	sm	*Melastomataceae*	*Memecylon griseo-violaceum ex* Gilg & Ledermann ex Engl.			2								1	1																	2
G	McPh	Méso	Sarco	sm	*Annonaceae*	*Monodora brevipes* Benth.		2	3								4	1																	5
At	MsPh	Méso	Sarco	mi	*Annonaceae*	*Monodora myristica* (Gaertn.) Duanal	1												1																1
G	McPh	Méso	Sarco	sm	*Annonaceae*	*Monodora tenuifolia* Benth.					1									1															1
GC	MsPh	Macro	Sarco	bm + sm	*Cecropiaceae*	*Musanga cecropioides* R.Br.ex Tedlie					1										1														1
GC	MsPh	Méso	Sarco	bm + sm	*Rubiaceae*	*Nauclea diderrichii* (De Wild. & Th. Dur.) Merrill	1																								1				1
BG	McPh	Méso	Pogo	bm	*Euphorbiaceae*	*Neoboutonia mannii* Benth. *var.mannii*						2					1		1																2
Ca	MsPh	Méso	Sarco	sm + mi	*Leguminosae*	*Newtonia duncanthomasii* Mackinder & C heek								5	1		2	1	1						1			1							6
CG	McPh	Méso	Sarco	mi	*Octoknemaceae*	*Octoknema genovefae* Villiers									1			1																	1
BG	McPh	Macro	Sarco	sm	*Thymeliaceae*	*Octolepis casearia* Oliv.											1	4	1	3	1	1													11
Ca	McPh	Méso	Sarco	sm	*Flacourtiaceae*	*Oncoba ovalis* Oliv.						1					1																		1
BG	McPh	Méso	Sarco	sm	*Rutaceae*	*Oricia lecomteana* Pierre				1							1																		1
At	McPh	Méso	Sarco	bm + sm	*Ochnaceae*	*Ouratea reticulata* (P. Beauv.) Engl.	1													1															1
GC	McPh	Méso	Sarco	sm	*Rubiaceae*	*Oxyanthus pallidus* Hiern			1									1																	1
GC	MsPh	Lepto	Sarco	bm	*Leguminosae*	*Parkia bicolor* A. Chev.					1																		1						1
CG	NnPh	Macro	Sarco	bm + sm	*Menispermaceae*	*Penianthus longifolius* Miers	11	50	23	21	2						84	21	1	1															107
At	NnPh	Micro	Sarco	mi	*Piperaceae*	*Peperomia pallucida* (L.) Kunth										1	1																		1
At	McPh	Méso	Sarco	sm + mi	*Piperaceae*	*Piper capense* Schumach. & Thonn. Cf.						1			3		4																		4
G	NnPh	Méso	Sarco	mi	*Piperaceae*	*Piper umbellatum* Linn.									4		4																		4
BG	McPh	Méso	Sarco	sm + mi	*Sapindaceae*	*Placodiscus opacus* Radlk.								2	17	16	27	7		1															35
At	MsPh	Méso	Sarco	sm + mi	*Araliaceae*	*Polyscias fulva* (Hiern) Harms										2			2	1			1												4
At	MsPh	Méso	Sarco	sm	*Rosaceae*	*Prunus africana* (Hook.f) Kalkm								1								1													1
GC	McPh	Méso	Sarco	mi	*Rubiaceae*	*Psychotria gabonica* Hiern										1	1																		1

TP	TB	TF	TD	TH	Families	Species	Plots										Average class of diameter																		
							R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	D15	D25	D35	D45	D55	D65	D75	D85	D95	D105	D115	D125	D135	D145	D155	D165	D175	D185	Effective
CG	McPh	Méso	Sarco	sm + mi	*Rubiaceae*	*Psychotria globosa* Hiern *var. globosa*								13	5	11	22	7																	29
At	McPh	Méso	Sarco	sm + mi	*Rubiaceae*	*Psychotria pedoncularis* (Salisb.) Steyerm.*var. pedoncularis*								2	5	4	6	5	1																12
Ca	NnPh	Méso	Sarco	sm	*Rubiaceae*	*Psychotria sp. aff. Subobliqua* Hiern		12	6	13	1						36	12																	48
At	McPh	Méso	Sarco	mi	*Rubiaceae*	*Psychotria succulenta* (Hiern) Petit									6		5	1																	6
GC	MgPh	Macro	Sarco	bm	*Myristicaceae*	*Pycnanthus angolensis* (Welw.) Warb.	2	1			2	7					7	2												1		1	1		12
Ca	MsPh	Méso	Sarco	sm	*Simaroubaceae*	*Quassia sanguinea* Cheek & Jondkind ined.		1									1																		1
GC	McPh	Méso	Sarco	sm	*Simaroubaceae*	*Quassia silvestris* Cheek & Jondlind ined.			2								1		1																2
CG	NnPh	Macro	Sarco	sm	*Violaceae*	*Rinorea gabunensis* Engl.			1												1														1
GC	Ms Ph	Méso	Sarco	sm	*Rubiaceae*	*Rothmannia hispida* (K. Schum.) Fagerlind			6		2						3	4	1																8
BG	NnPh	Méso	Sarco	mi	*Rubiaceae*	*Rutidea glabra* Hiern										1		1																	1
CG	Phgr	Méso	Sarco	mi	*Celastraceae*	*Salacia loloensis* Loes.*var.loloensis*									2	14	5	4	4																16
BG	Phgr	Méso	Sarco	sm	*Celastraceae*	*Salacia mamba* N. Hallé		12		1							14	2																	13
GC	McPh	Méso	Sarco	bm + sm	*Burseraceae*	*Santiria trimera* (Oliv.) Aubr.		3	13	3	3	1					14	8	8	1	2	2	3	1	2	3			2			1			47
GC	McPh	Micro	Sarco	sm	*Araliaceae*	*Schefflera barteri* (Seem.) Harms								2						1			1												2
GC	McPh	Micro	Sarco	sm	*Anacardiaceae*	*Sorindeia grandifolia* Engl.			24	1	35	5		1			30	19	5	6	5								1						66
At	MsPh	Méso	Sarco	bm + sm	*Malvaceae*	*Sterculia tragacantha* Lindl.				1															1										1
GC	McPh	Méso	Sarco	bm	*Olacaceae*	*Strombosia grandifolia* Hook. f. ex Benth.			1			3		1			3				1	1													5
Aam	MsPh	Méso	Sarco	Large	*Olacaceae*	*Strombosia pustulata* Oliv.	2	1	1	3	4	4		1		2	2		4	1		3	1	2	1	1	1	1	1						18
BG	McPh	Méso	Pogo	bm + sm	*Apocynaceae*	*Strophanthus thollonii* Franch.	14	17		1				4	1	1	16	17	3		1														37
G	MsPh	Micro	Sarco	sm	*Myrtaceae*	*Syzygium staudtii* (Engl.) Mildbr.			1																	1									1
At	McPh	Micro	Sarco	sm + mi	*Apocynaceae*	*Tabernaemontana ventricosa* Hochst.ex A. DC.			1		1			5	1	3	3	1	2	3		2	1			1									13
CG	McPh	Micro	Sarco	bm + sm	*Apocynaceae*	*Tabernaemontana inconspicua* Stapf	4										1	1		1		1													4

TP	TB	TF	TD	TH	Families	Species	Plots										Average class of diameter																		
							R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	D15	D25	D35	D45	D55	D65	D75	D85	D95	D105	D115	D125	D135	D145	D155	D165	D175	D185	Effective
GC	McPh	Méso	Sarco	mi	*Rubiaceae*	*Tarenna eketensis* Wernham										1		1																	1
CG	Phgr	Micro	Scléro	sm	*Acanthaceae*	*Mendoncia gilgiana* (Lindau) Benoist		1										1																	1
GC	Phgr	Micro	Scléro	sm	*Acanthaceae*	*Thunbergia vogeliana* Benth.				1							1																		1
AM	MsPh	Macro	Sarco	bm	*Moraceae*	*Treculia africana* Decne *var.africana*	1													1															1
At	McPh	Méso	Sarco	sm + mi	*Rubiaceae*	*Tricalysia pallens* Hiern		2	4	2	4				1		9	5	1	1			1												17
GC	McPh	Méso	Sarco	bm + sm	*Meliaceae*	*Trichilia prieureana* A.Juss.*subsp.vermoesenii* J.J.de Wilde	3	6		1		1					6	4	1							1									12
CG	MsPh	Méso	Sarco	Large	*Meliaceae*	*Trichilia rubescens* Oliv.	6		3		2	3			3	2	14	1		2		2	1		2			1							23
CG	MsPh	Méso	Sarco	sm	*Anacardiaceae*	*Trichoscypha acuminata* Engl.		7				2					6	1		1		1													9
At	McPh	Méso	Sarco	sm	*Anacardiaceae*	*Trichoscypha lucens* Oliv.		1									1																		1
BG	MsPh	Méso	Sarco	sm	*Anacardiaceae*	*Trichoscypha mannii* Hook. f.					1							1																	1
GC	MsPh	Méso	Sarco	bm + sm	*Meliaceae*	*Turraeanthus africanus* (Welw.ex C.CD.) Pellegr.	5	3				4					7			1						1		2	1	1					13
GC	Phgr	Méso	Scléro	mi	*Urticaceae*	*Urera repens* (Wedd.) Rendle									1		1																		1
CG	McPh	Micro	Sarco	sm + mi	*Opiliaceae*	*Urobotrya congolana* (Baill.) Hiepko *subsp.congolana*	1	1						1	1	5	2	1	1	3				1	1										9
At	McPh	Méso	Sarco	sm	*Annonaceae*	*Uvaria angolensis* Welw.ex Oliv.		1									1																		1
BG	McPh	Méso	Sarco	bm + sm	*Annonaceae*	*Uvariodendron giganteum* (Engl.) R. E. Fr.	1			1							1	1																	2
CG	McPh	Méso	Sarco	sm	*Annonaceae*	*Uvariopsis vanderystii* Robyns & Ghesq			2								1				1														2
At	McPh	Micro	Sarco	sm + mi	*Annonaceae*	*Xylopia aethiopica* (Dunal) A. Rich.			1					2		2			2	1	1		1												5
GC	MsPh	Méso	Sarco	sm	*Rutaceae*	*Zanthoxylum gilletii (De Wild) Waterman*		2			1						1				1					1									3
GC	McPh	Micro	Sarco	bm + sm	*Rutaceae*	*Zanthoxylum rubescens* Hook. f	1											1																	1
CG	MsPh	Micro	Sarco	mi	*Anacardiaceae*	*Sorindeia winkleri* Engl.										1						1													1
						Total	**121**	**174**	**167**	**102**	**109**	**101**	**126**	**81**	**77**	**126**	**570**	**252**	**100**	**74**	**35**	**33**	**31**	**16**	**22**	**21**	**4**	**8**	**8**	**3**	**2**	**3**	**1**	**1**	**1184**

Appendix 2. The 51 families with their values of relative dominance, relative density, relative diversity and FIV in decreasing order.

Families	Relative dominance [× 100 %]	Families	Relative density [× 100 %]	Families	Relative diversity [× 100 %]	Families	FIV [× 300 %]
Meliaceae	20.74	*Meliaceae*	17.27	*Rubiaceae*	10.89	*Meliaceae*	41.22
Euphobiaceae	14.78	*Rubiaceae*	13.70	*Euphorbiaceae*	7.69	*Rubiaceae*	32.40
Burseraceae	10.61	*Burseraceae*	10.00	*Annonaceae*	7.05	*Euphorbiaceae*	30.94
Malvaceae	10.61	*Menispermaceae*	9.96	*Sapindaceae*	5.69	*Malvaceae*	23.55
Clusiaceae	9.65	*Malvaceae*	9.09	*Moraceae*	4.48	*Burseraceae*	21.25
Rubiaceae	7.81	*Euphorbiaceae*	8.47	*Anacardiaceae*	3.85	*Clusiaceae*	20.13
Olacaceae	6.98	*Clusiaceae*	7.27	*Malvaceae*	3.85	*Moraceae*	17.24
Moraceae	6.40	*Olacaceae*	7.27	*Leguminosae*	3.21	*Anacardiaceae*	15.57
Apocynaceae	5.38	*Anacardiaceae*	7.26	*Clusiaceae*	3.21	*Olacaceae*	15.53
Leguminosae	4.77	*Moraceae*	6.36	*Meliaceae*	3.21	*Sapotaceae*	14.29
Sapotaceae	4.72	*Sapotaceae*	6.36	*Sapotaceae*	3.21	*Menispermaceae*	13.78
Anacardiaceae	4.46	*Apocynaceae*	4.84	*Rutaceae*	2.56	*Annonaceae*	13.05
Annonaceae	4.05	*Sapindaceae*	4.66	*Apocynaceae*	1.92	*Sapindaceae*	12.80
Thymeliaceae	3.58	*Leguminosae*	4.55	*Combretaceae*	1.92	*Leguminosae*	12.53
Lauraceae	3.22	*Lauraceae*	4.55	*Flacourtiaceae*	1.92	*Apocynaceae*	12.14
Menispermaceae	3.10	*Combretaceae*	4.28	*Lauraceae*	1.92	*Myristicaceae*	10.74
Myrtaceae	2.57	*Thymeliaceae*	3.07	*Piperaceae*	1.92	*Lauraceae*	9.69
Sapindaceae	2.45	*Caricaceae*	2.73	*Simaroubaceae*	1.92	*Combretaceae*	8.02
Combretaceae	1.82	*Myristicaceae*	2.73	*Vitaceae*	1.92	*Thymeliaceae*	7.93
Caricaceae	1.62	*Celastraceae*	2.70	*Acanthaceae*	1.28	*Myrtaceae*	6.27
Families	**Relative dominance [× 100 %]**	**Families**	**Relative density [× 100 %]**	**Families**	**Relative diversity [× 100 %]**	**Families**	**FIV [× 300 %]**
Alangiaceae	1.51	*Myrtaceae*	2.42	*Agavaceae*	1.28	*Celastraceae*	5.27
Celastraceae	1.30	*Annonaceae*	1.96	*Araliaceae*	1.28	*Caricaceae*	4.99
Opiliaceae	1.23	*Araliaceae*	1.82	*Celastraceae*	1.28	*Araliaceae*	4.01
Araliaceae	0.92	*Opiliaceae*	1.82	*Icacinaceae*	1.28	*Rutaceae*	3.47
Rutaceae	0.87	*Alangiaceae*	0.91	*Melastomataceae*	1.28	*Alangiaceae*	3.06
Myristicaceae	0.82	*Rhamnaceae*	0.91	*Myristicaceae*	1.28	*Piperaceae*	2.92
Bignoniaceae	0.67	*Rutaceae*	0.91	*Myrtaceae*	1.28	*Simaroubaceae*	2.73
Rosaceae	0.59	*Piperaceae*	0.84	*Ochnaceae*	1.28	*Vitaceae*	2.59
Melastomataceae	0.58	*Bignoniaceae*	0.65	*Olacaceae*	1.28	*Melastomataceae*	2.51
Rhamnaceae	0.56	*Leeaceae*	0.65	*Thymeliaceae*	1.28	*Flacourtiaceae*	2.48
Violaceae	0.39	*Melastomataceae*	0.65	*Alangiaceae*	0.64	*Opiliaceae*	2.19

Families	Relative dominance [× 100 %]	Families	Relative density [× 100 %]	Families	Relative diversity [× 100 %]	Families	FIV [× 300 %]
Cecropiaceae	0.34	*Simaroubaceae*	0.56	*Bignoniaceae*	0.64	*Rhamnaceae*	2.11
Vitaceae	0.30	*Agavaceae*	0.47	*Boraginaceae*	0.64	*Bignoniaceae*	1.96
Flacourtiaceae	0.28	*Tiliaceae*	0.47	*Burseraceae*	0.64	*Agavaceae*	1.94
Polygalaceae	0.28	*Vitaceae*	0.37	*Caricaceae*	0.64	*Ochnaceae*	1.69
Tiliaceae	0.26	*Flacourtiaceae*	0.28	*Cecropiaceae*	0.64	*Icacinaceae*	1.64
Simaroubaceae	0.25	*Icacinaceae*	0.28	*Comariopsidaceae*	0.64	*Acanthaceae*	1.53
Cyatheaceae	0.24	*Passifloraceae*	0.28	*Cyatheaceae*	0.64	*Leeaceae*	1.44
Ochnaceae	0.23	*Acanthaceae*	0.19	*Lecythidaceae*	0.64	*Tiliaceae*	1.37
Boraginaceae	0.22	*Cyatheaceae*	0.19	*Leeaceae*	0.64	*Rosaceae*	1.33
Lecythidaceae	0.21	*Lecythidaceae*	0.19	*Menispermaceae*	0.64	*Violaceae*	1.13
Agavaceae	0.19	*Ochnaceae*	0.19	*Octoknemaceae*	0.64	*Cecropiaceae*	1.07
Piperaceae	0.16	*Boraginaceae*	0.09	*Opiliaceae*	0.64	*Cyatheaceae*	1.06
Leeaceae	0.15	*Cecropiaceae*	0.09	*Passifloraceae*	0.64	*Lecythidaceae*	1.04
Peripiocaceae	0.10	*Comariopsidaceae*	0.09	*Peripiocaceae*	0.64	*Polygalaceae*	1.02
Icacinaceae	0.08	*Octoknemaceae*	0.09	*Polygalaceae*	0.64	*Passifloraceae*	0.97
Octoknemaceae	0.08	*Peripiocaceae*	0.09	*Rhamnaceae*	0.64	*Boraginaceae*	0.95
Acanthaceae	0.06	*Polygalaceae*	0.09	*Rosaceae*	0.64	*Peripiocaceae*	0.84
Passifloraceae	0.05	*Rosaceae*	0.09	*Tiliaceae*	0.64	*Octoknemaceae*	0.82
Urticaceae	0.02	*Urticaceae*	0.09	*Urticaceae*	0.64	*Urticaceae*	0.75
Comariopsidaceae	0.01	*Violaceae*	0.09	*Violaceae*	0.64	*Comariopsidaceae*	0.74

Appendix 3. The 156 species with their basal areas; their relative frequency, relative density, relative dominance and IVI in decreasing order.

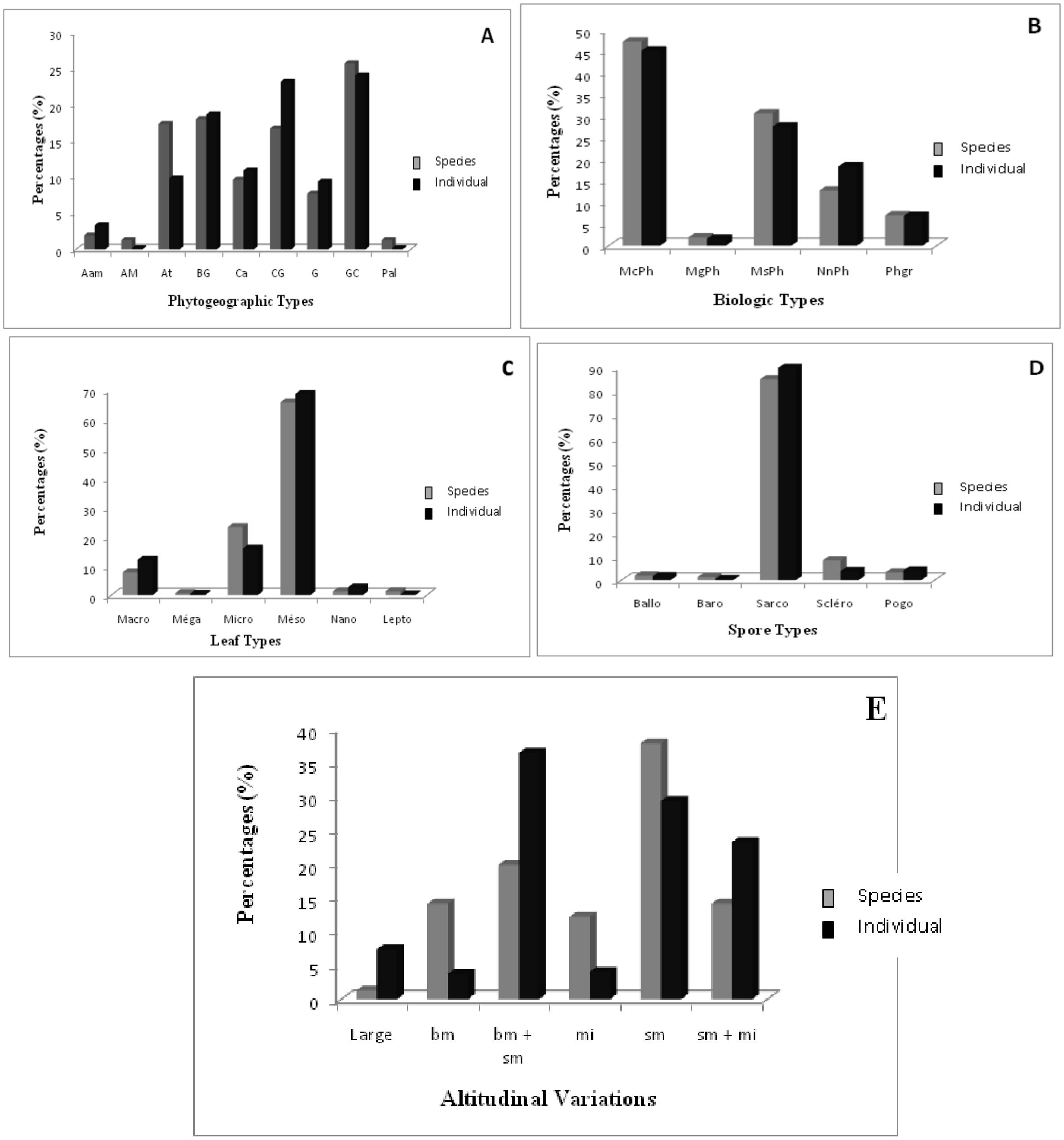
Species	Number of individuals	Basal area [m²]	Relative fréquency [x× 100 %]	Relative density [× 100 %]	Relative dominance [× 100 %]	IVI [× 300 %]
Santiria trimera (Oliv.) Aubr.	47	9.59	5.06	3.97	10.61	19.64
Carapa procera D.C	20	9.92	7.59	1.69	10.03	19.31
Cola acuminata (P.Beau.) Schott et Endl.	44	7.86	6.33	3.72	5.51	15.56
Penianthus longifolius Miers	107	1.74	1.67	9.96	3.09	14.72
Drypetes leonensis Pax	46	6.82	3.80	3.89	5.32	13.01
Strombosia pustulata Oliv.	18	7.84	3.80	1.52	6.98	12.30
Turraeanthus africana (Welw. ex C. CD.) Pellegr.	13	6.39	3.80	1.09	6.69	11.58
Pycnanthus angolensis (Welw.) Warb.	12	6.23	2.53	1.01	6.73	10.27
Englerophytum stelechanthum K. Krause	33	3.83	3.80	2.79	3.28	9.87
Allanblackia gabonensis Oliv.	12	3.54	1.79	3.01	3.92	8.72
Ficus sur Forssk.	9	3.99	1.89	3.12	3.71	8.72
Trichilia rubescens Oliv.	23	4.09	3.80	1.75	3.17	8.72
Garcinia lucida Vesque	21	2.77	1.59	2.77	4.19	8.56
Sorindeia grandifolia Engl.	66	1.73	1.34	4.08	3.08	8.50
Macaranga occidentalis (Müll. Arg.) Müll. Arg.	11	3.52	1.00	1.02	6.28	8.31
Beilschmiedia crassipes (Engl. & K. Krause) Robyns & Wilezek	13	2.15	2.53	5.84	2.84	8.21
Cylicomorpha somlsii (Urb.) Urb.	5	1.46	3.79	2.73	1.62	8.14
Garcinia smeathmannii (Planch. & Triana) Oliv.	11	2.18	2.61	1.84	3.45	7.89
Psychotria sp. aff. subobliqua Hiern	48	0.72	1.67	4.47	1.29	7.43
Eugenia obanensis Bak. F	27	1.88	2.34	2.42	2.57	7.33
Strophathus thollonii Franch.	37	1.17	1.67	3.45	2.09	7.21
Drypetes preussii (Pax) Hutch.	15	3.79	2.53	1.82	2.85	7.20
Cola grandifolia	28	2.92	1.34	2.42	2.97	6.73
Newtonia duncanthomasii Mackinder & Cheek	6	1.89	1.94	2.19	2.19	6.31
Psychotria globosa Hiern *var. globosa*	29	1.43	1.00	2.70	2.56	6.26
Trichilia prieureana A. Juss. *subsp. vermoesenii* J.J. de Wilde	12	1.02	2.94	1.93	1.30	6.17
Beilschmiedia acuta Kosterm.	9	1.42	1.59	2.47	1.90	5.98
Urobotrya congolana (Baill.) Kiepko *subsp. congolana*	9	1.66	2.53	1.82	1.27	5.62
Tabernaemontana ventricosa Hochst. ex A. DC.	11	1.37	2.01	1.02	2.44	5.47
Placodiscus opacus Radlk.	35	0.66	1.00	3.26	1.17	5.43
Dicranolepis vestita Engl.	22	1.04	1.34	2.05	1.85	5.24
Tricalysia pallens Hiern	17	0.80	2.01	1.58	1.43	5.02
Xylopia aethiopica (Durand) A. Rich	5	1.70	1.00	0.47	3.04	4.51
Chrysophyllum lacourtianum De Wild.	4	0.84	2.27	1.19	1.05	4.51
Zanthoxylum gilletii (De Wild) Waterman	3	0.99	1.94	1.09	1.23	4.26
Nauclea diderrichii (De Wild. & Th. Dur.) Merrill	1	1.77	1.27	0.91	1.96	4.14
Polyscias fulva (Hiern) Harms	2	0.69	1.94	1.19	0.96	4.09
Combretum bracteatum (M. A. Lawson) Engl. & Diels	19	0.37	1.34	1.77	0.67	3.77

Species	Number of individuals	Basal area [m²]	Relative fréquency [x× 100 %]	Relative density [× 100 %]	Relative dominance [× 100 %]	IVI [× 300 %]
Parkia bicolor A. Chev.	1	1.43	1.27	0.91	1.58	3.76
Ficus mucuso Welw. ex Ficalho	4	0.83	1.59	1.19	0.95	3.73
Cola cauliflora Mast.	5	1.15	1.00	0.47	2.05	3.51
Schefflera barteri (Seem.) Harms	2	0.60	1.59	0.99	0.77	3.37
Cola verticillata (Thonn.) Stapf. ex A. Chev.	1	1.00	1.27	0.91	1.11	3.28
Crotonogyne preussii Pax	1	1.00	1.27	0.91	1.11	3.28
Anonidium mannii (Oliv.) Engl. & Diels	2	0.59	1.59	0.99	0.68	3.27
Psychotria pedoncularis (Salisb.) Steyerm. *var. pedoncularis*	12	0.41	1.34	1.12	0.73	3.18
Octolepis casearia Oliv.	11	0.97	0.33	1.02	1.73	3.09
Antiaris toxicaria var. welwistchii (Engl.)	1	0.79	1.27	0.91	0.87	3.04
Ficus ottoniifolia (Miq.) Miq. *subsp. Ottoniifolia*	1	0.79	1.27	0.91	0.87	3.04
Syzygium staudtii (Engl.) Milbr.	1	0.79	1.27	0.91	0.87	3.04
Garcinia mannii Oliv.	6	0.24	2.01	0.56	0.43	3.00
Chrysophyllum africanum A. DC.	1	0.67	1.27	0.91	0.74	2.91
Klaineanthus gaboniae Pierre ex Prain	1	0.64	1.27	0.91	0.70	2.88
Sterculia tragacatha Lindl.	1	0.64	1.27	0.91	0.70	2.88
Daniella oliveri (Rolfe) Hutch. & Dalziel	1	0.61	1.27	0.91	0.68	2.85
Alchornea floribunda Müll. Arg.	16	0.18	1.00	1.49	0.33	2.82
Salacia mamba N. Hallé	13	0.48	0.67	1.21	0.86	2.74
Erythrina mildbraedii Harms	1	0.50	1.27	0.91	0.56	2.73
Hypodaphnis zenkeri (Engl.) Stapf	1	0.50	1.27	0.91	0.56	2.73
Maesopsis eminii Engl.	1	0.50	1.27	0.91	0.56	2.73
Combretaceae Liane	15	0.36	0.67	1.40	0.65	2.71
Eriocoelum petiolare Radlk.	1	0.46	1.27	0.91	0.50	2.68
Combretum paniculatum Vent.	12	0.29	1.00	1.12	0.51	2.63
Cleistopholis patens (Benth.) Engl. & Diels	1	0.39	1.27	0.91	0.43	2.60
Salacia loloensis Loes. *var loloensis*	16	0.24	0.67	1.49	0.43	2.59
Laccodiscus ferrugineus (Baker) Radlk.	7	0.49	1.00	0.65	0.87	2.53
Ixora guineensis Benth.	8	0.19	1.34	0.75	0.33	2.42
Strombosia grandifolia Hook. ex. Benth.	5	0.53	1.00	0.47	0.95	2.42
Trichoscypha acuminata Engl.	9	0.44	0.67	0.84	0.78	2.29
Memecylon dasyanthum Gilg & Ledermann ex Engl.	5	0.27	1.00	0.47	0.49	1.96
Leea guineensis G. Don	7	0.08	1.00	0.65	0.15	1.80
Rothmannia hispida (K. Schum.) Fagerlind	8	0.20	0.67	0.75	0.35	1.77
Desplatsia dewevrei (De W ild. & T. Durand)	5	0.15	1.00	0.47	0.26	1.73
Alangium chinense (Lour.) Harms	1	1.37	1.27	0.91	1.51	1.69
Canthium vulgare (K. Schum.) Bullock	9	0.08	0.67	0.84	0.15	1.66
Kigelia africana (Lam.) Benth.	7	0.38	0.33	0.65	0.67	1.66
Chrysophyllum welwistchii Engl.	2	0.40	0.67	0.19	0.72	1.58
Tabernaemontana inconspicua Stapf	4	0.48	0.33	0.37	0.85	1.56

Species	Number of individuals	Basal area [m²]	Relative fréquency [x× 100 %]	Relative density [× 100 %]	Relative dominance [× 100 %]	IVI [× 300 %]
Leptonychia pallida K. Schum.	5	0.05	1.00	0.47	0.08	1.55
Entandrophragma angolensis (Welw.) C.D	4	0.08	1.00	0.37	0.13	1.51
Monodora brevipes Benth.	5	0.09	0.67	0.47	0.17	1.30
Coffea bakossii Cheek & Bridson	3	0.17	0.67	0.28	0.31	1.25
Psychotria succulenta (Hiern) Petit	6	0.17	0.33	0.56	0.31	1.20
Piper capense Schumach & Thonn. Cf.	4	0.04	0.67	0.37	0.07	1.12
Allophylus bullatus Radlk	3	0.05	0.67	0.28	0.09	1.04
Brucea guineensis G. Don	3	0.05	0.67	0.28	0.09	1.04
Prunus africana (Hook. f) Kalkm	1	0.33	0.33	0.09	0.59	1.02
Dracaena fragrans (L) Ker-Gawl.	3	0.03	0.67	0.28	0.06	1.01
Barteria solida Breteler	3	0.03	0.67	0.28	0.05	1.00
Dracaena sp. aff. phrynioides Hook.	2	0.07	0.67	0.19	0.13	0.99
Coelocaryon preussii Warb.	1	0.31	0.33	0.09	0.56	0.98
Uvariodendron giganteum (Engl.) R. E. Fr.	2	0.05	0.67	0.19	0.09	0.95
Sorindeia winkleri Engl.	1	0.28	0.33	0.09	0.50	0.93
Uvariopsis vanderystii Robyns & Ghesq	2	0.20	0.33	0.19	0.36	0.88
Rinorea gabunensis Engl.	1	0.22	0.33	0.09	0.39	0.82
Piper umbellatum Linn.	4	0.04	0.33	0.37	0.06	0.77
Alchornea hirtella Benth. *fa. Glabata* (Müll. Arg.) Pax & K. Hoffm.	2	0.13	0.33	0.19	0.24	0.76
Cyathea camerooniana Hook. *var. zenkeri* (Diels) Tardieu	2	0.13	0.33	0.19	0.24	0.76
Musanga cecropioides R. Br. ex. Tedlie	1	0.19	0.33	0.09	0.34	0.76
Crateranthus talbotii Bak. f.	2	0.12	0.33	0.19	0.21	0.73
Carpolobia alba G. Don	1	0.16	0.33	0.09	0.28	0.71
Neoboutonia mannii Benth. *var. mannii*	2	0.08	0.33	0.19	0.14	0.66
Quassia silvestris Cheek & Jondlind ined.	2	0.08	0.33	0.19	0.14	0.66
Antidesma laciniantum Müll. Arg. *var. laciniantum*	1	0.13	0.33	0.09	0.22	0.65
Cordia aurantiaca Bak.	1	0.13	0.33	0.09	0.22	0.65
Homalium africanum (Hook. f.) Benth.	1	0.12	0.33	0.09	0.21	0.64
Ouratea reticulata (P. Beauv.) Engl.	1	0.11	0.33	0.09	0.20	0.63
Memecylon griseo-violaceum Gilg & Ledermann ex. Engl.	2	0.05	0.33	0.19	0.09	0.62
Treculia africana Decne *var. Africana*	1	0.11	0.33	0.09	0.19	0.62
Cissus amoena Gilg & Brandt	2	0.05	0.33	0.19	0.09	0.61
Monodora tenuifolia Benth.	1	0.10	0.33	0.09	0.18	0.61
Mammea africana Sabine	2	0.04	0.33	0.19	0.08	0.60
Ficus exasperata Vahl	1	0.06	0.33	0.09	0.11	0.57
Isolona zenkeri Engl.	2	0.02	0.33	0.19	0.04	0.56
Antidesma vogelianum Müll. Arg.	2	0.02	0.33	0.19	0.03	0.55
Coffea montekupensis Stoffelen	1	0.07	0.33	0.09	0.12	0.55
Lasianthera africana P. Beauv.	2	0.02	0.33	0.19	0.03	0.55

Species	Number of individuals	Basal area [m²]	Relative fréquency [x× 100 %]	Relative density [× 100 %]	Relative dominance [× 100 %]	IVI [× 300 %]
Cissus barbeyana De Wild. & T. Durand	1	0.06	0.33	0.09	0.11	0.54
Cryptolepis sanguinolenta (Lindl.) Schltr.	1	0.06	0.33	0.09	0.10	0.53
Aningeria robusta (A. Chev.) Aubrév. & Pellegr.	1	0.05	0.33	0.09	0.09	0.52
Cissus aralioides (Welw. ex. Baker) Planch	1	0.05	0.33	0.09	0.10	0.52
Monodora myristica (Gaertn.) Duanal	1	0.05	0.33	0.09	0.10	0.52
Allophylus africanus P. Beauv. *var. africanus*	1	0.05	0.33	0.09	0.09	0.51
Octoknema genovefae Villiers	1	0.05	0.33	0.09	0.08	0.51
Clausena anisata (Wild.) Hook. f. ex Benth.	1	0.04	0.33	0.09	0.07	0.50
Cuviera longiflora Hiern	1	0.04	0.33	0.09	0.07	0.50
Eriocoelum racemosum Baker	1	0.04	0.33	0.09	0.07	0.50
Deinbollia rambaensis Pellegr.	1	0.03	0.33	0.09	0.06	0.48
Icacina mannii Oliv.	1	0.03	0.33	0.09	0.06	0.48
Oxyanthus pallidus Hiern	1	0.03	0.33	0.09	0.06	0.48
Trichoscypha mannii Hook. f.	1	0.03	0.33	0.09	0.06	0.48
Zanthoxylum rubescens Hook. f.	1	0.03	0.33	0.09	0.06	0.48
Caloncoba glauca (P. Beauv.) Gilg	1	0.03	0.33	0.09	0.05	0.47
Mallotus oppositifolius (Geisel.) Müll. Arg.	1	0.03	0.33	0.09	0.05	0.47
Mendoncia gilgiana (Lindau) Benoist	1	0.03	0.33	0.09	0.05	0.47
Campylospermum elongatum (Oliv.) Tiegh.	1	0.02	0.33	0.09	0.04	0.46
Ficus trichopoda Baker	1	0.02	0.33	0.09	0.04	0.46
Gardenia vogelii Hook. f. ex Planch.	1	0.02	0.33	0.09	0.04	0.46
Lannea welwitschii (Hiern) Engl.	1	0.02	0.33	0.09	0.04	0.46
Rutidea glabra Hiern	1	0.02	0.33	0.09	0.04	0.46
Tarenna eketensis Wernham	1	0.02	0.33	0.09	0.04	0.46
Adenocarpus mannii (Hook. f.) Hook. f.	1	0.01	0.33	0.09	0.02	0.45
Oncoba ovalis Oliv.	1	0.01	0.33	0.09	0.02	0.45
Peperomia pellucida (L.) Kunth	1	0.01	0.33	0.09	0.02	0.45
Urera repens (Wedd.) Rendle	1	0.01	0.33	0.09	0.02	0.45
Uvaria angolensis Welw. ex Oliv.	1	0.01	0.33	0.09	0.02	0.45
Allophylus grandifolius (Baker) Radlk.	1	0.02	0.33	0.09	0.01	0.44
Artabotrys congolensis De Wild & T. Durand	1	0.01	0.33	0.09	0.01	0.44
Bolbitis gaboonensis (Hook.) Alston	1	0.01	0.33	0.09	0.01	0.44
Deinbollia sp. aff. maxima Gilg	1	0.01	0.33	0.09	0.01	0.44
Erythrococca anomala (Juss. ex Poir.) Prain	1	0.01	0.33	0.09	0.01	0.44
Oricia lecomteana Pierre	1	0.01	0.33	0.09	0.01	0.44
Psychotria gabonia Hiern	1	0.01	0.33	0.09	0.01	0.44
Quassia sanguinea Cheek & Jondlind ined.	1	0.01	0.33	0.09	0.01	0.44
Thunbergia vogeliana Benth.	1	0.01	0.33	0.09	0.01	0.44
Trichoscypha lucens Oliv.	1	0.01	0.33	0.09	0.01	0.44

Appendix 4. Rough and balanced spectres of phytogéographic type (TP), biologic type (TB), leaf types (TF), spore type (TD) and steep type (TH) of the species recorded in Mount Kupe submontane forest.



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